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SUPPLY IN MODERN WAR

SUPPLY
IN MODERN WAR

by

Brevet Lieut.-Colonel
G. C. SHAW
R.A.O.C.

with a preface by

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As a token of regard
to

B. A. H.

our Director, in whose time as such
Mechanization turned
from a trickle
to a flood

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PREFACE BY
MAJOR-GENERAL J. F. C. FULLER

Surely one of the strangest things in military history is the almost complete silence upon the problem of supply. Not in ten thousand books written on war is there to be found one on this subject; yet, as Major Shaw writes, 'it forms the basis on which rests the whole structure of war; it is the very foundation of Tactics and Strategy'.

For example, examine the most epoch-making war ever fought, namely the conquests of Alexander the Great. Though with a great army he marched 22,000 miles, we are not told how he supplied or fed it. Here and there only do we catch a glimpse of his system, which must have been highly organized; for instance, when somewhere near Termez in modern Turkistan, Plutarch informs us that 'The King had a present of Grecian fruit brought him from the sea-coast, which was so fresh and beautiful, that he was surprised at it'. So also is it with the campaigns of Hannibal and Caesar, the problem of supply is barely mentioned. Not until the eighteenth century do military writers show any marked interest in the subject, and then very theoretically. At length Napoleon gives expression to the fundamental principle that 'an army marches upon its belly'.

Perturbed by supply, it was he who founded the present canning industry by offering to the inventive genius of France a substantial prize to anyone who would discover a means of preserving meat. The winner, whose name I now forget, produced a glass container, the forerunner of the 'tin' can. And was it not Colonel T. E. Lawrence who said with profound truth, that 'The invention of bully-beef has modified land-war more profoundly than the invention of gunpowder', because 'range is more to strategy than force'.

Turning now to the times in which we live, the World War showed us how immense the supply problem is; in fact it may be called a war between two great supply systems. A war between the Midlands and the Ruhr, in which the former eventually won, but at stupendous cost, because strategy was, on account of bullet-power, almost rangeless. Yet during it a revolutionary change occurred, first in the normal supply systems of armies, and secondly in their tactical instruments. This revolution was created by the petrol engine, which, adapted to lorry and motor-car, rapidly began to oust the horse, and when used in tank and aeroplane foreshadowed a totally new form of war. 'To-day', Major Shaw writes, 'the soldier stands on the threshold of an era of military industrialization; one akin to that which commenced in the life of the civil community more than a hundred years ago, when machinery first began to replace man in mass.' Therefore his object in this book is to discover the influence of this stupendous change on the problem of supply and work out its principles.

It will be seen from this that his task is one of fundamental importance, and strange as it may seem, though scores of books have now examined the tactical changes which this revolution is effecting, so far as my knowledge goes, his is the first in any language which has examined it from its supply side.

Though he states that his subject is a dull one, I disagree, for not only is it a deeply fascinating one, but one vital to modern generalship; because Napoleon's fundamental principle is not only as true as ever, but must remain so as long as war endures.

Recently in Abyssinia I watched how fascinating it can be. When early in last October[1] I went as a journalist to Eritrea, I realized forthwith that not tactics or strategy but supply was the one all-absorbing problem of the Italo-Abyssinian War. On the Italian side it took the form of the road, on the Abyssinian that of the food sack. In the one range depended on labour, in the other it was limited by human muscular power which could not be increased. Logically enough, the weaker in man-power became the Italian front and the stronger in labour-power the Italian rear, the more was range accelerated. During the final move on Addis Ababa no less than 170,000 men were working on the roads and a complete Army Corps in two separate places was for several days on end supplied by aircraft. In the Danakil desert, in order to supply the column at Sardo with fresh meat, as it was found impossible, on account of the heat, to transport carcasses, live bullocks were carried in aeroplanes from Assab on the Red Sea, flown over 200 miles and then dropped by parachute to earth.

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[1] i.e. October 1935.—*Author's note.*

I agree with the author of this vitally important book, that there is practically no supply problem which modern inventive genius cannot solve. But, be it remembered, unless the soldier has studied the problem of supply in all its forms, this genius will be wasted. Time and again have I heard educated soldiers proclaim that the motorization and mechanization of armies will throw such a strain on supply as to render it inoperative; yet the very reverse is the case. The same argument was vouchsafed when the steamship was first introduced, it being said that no vessel could be built which would carry enough coal in her bunkers to enable her to cross the Atlantic. These critics seldom if ever examine facts. For instance they do not realize that though during the World War we shipped over to France 5,253,538 tons of ammunition, including over 170,000,000 shells, the greatest single item of tonnage was oats and hay, namely, 5,438,602 tons, and what with the sea transport of thousands upon thousands of horses, the total shipping required was approximately equivalent to the shipping we lost through submarine attack. Could we have dispensed with the horse there would have been no need to issue a single food ticket. Of petrol and M.T. stores but 758,614 tons were transported and of tanks and stores only 68,167.

On this subject Major Shaw says: 'To conclude, the greatest of all arguments in favour of the employment of an entirely mechanized force appears to be that, so far from its supply being likely to strangle its mobility—as critics aver—its elimination of heavy man-power will mean the abolition of the colossal supply tonnages of the past. Thus, by way of the fighting vehicle, and low man-power, will be once again recovered a mobility of manœuvre, lost since the Napoleonic wars.' The truth of this has been fully proved during the recent Italo-Abyssinian War, therefore this book is certainly one which should be studied and read.

J. F. C. FULLER,
Major-General.

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PART I: MAN-POWER

‘Ahem,’ said the mouse with an important air. ‘Are you all ready? This is the driest thing I know. Silence, all round, if you please.’

—*Alice’s Adventures in Wonderland*

Chapter One

IMPORTANCE OF SUPPLY

The Problem of Supply To-day—Necessity for Principles

From the dawn of history until the soldier first adopted the steam-engine, and then later the internal-combustion (I.C.) engine, for his needs in war, he has relied for movement on Nature's gifts —his strength of muscle and lung, or that of his domesticated animal. His pace has been Nature's pace, and his speed governed by the adaptability she gives him, and the limitations she imposes. His inventive genius, with perhaps one or two notable exceptions such as Gustavus Adolphus and Sherman, has been all directed towards improving his weapons, from the 'sarissa' of Philip of Macedon to the Big Berthas of the Great War. So light cavalries to-day, if anything, are less mobile than Genghiz Khan's Mongol riders who swept across half a continent to terrify Europe; infantry march no farther or faster than did Rome's legionaries; and their animal transport flogs along behind no better or worse than that of the legion. Imperial mails then travelled forty to fifty miles in a day's journey, and the traveller on foot averaged twenty miles a day. Even in what may be called modern times there has been no advance on these speeds for long-distance travel, until the railway came.

The Problem of Supply To-day

It is questionable whether the revolution in speed due to the machine is even yet fully realized by the soldier. Yet now, for the first time in the history of war on land, he may seek and attack his foe otherwise than through his own muscular effort, or that of his animal; for instead, tank, truck, lorry, or motor-cycle will bear him there; while machine-gun, automatic, or quick-firer, and other power-tools, relieve him of many a brute burden of the past. Here is a way of war, pregnant with change to affect its whole art: mechanization, the supplanting of man in mass by the machine; mechanization, which has crept from the purlieus of industry to the rear and through the tail of armies, till at last, enlarging power and minimizing effort, it moves the combatant himself on track or wheel.

The military problems following in its train demand solution. For if in the leisure of peace logic fail or experiment be denied, then in war there will be failure—costly failure, leading maybe to long-drawn-out trench warfare, with all its attendant massacre and expenditure in treasure; to grave inefficiency in administration, as was revealed at the beginning of the Peninsular War; or perhaps to a crash of the supply departments, as in the Crimean War, when all the lessons learnt in the Napoleonic wars, half a century before, had been forgotten. A sorrowful lesson it was to the then administrators of the British Army, and one which drew from Kinglake the scathing comment: 'When England flew to arms against Russia, she was not only without a land transport corps, but even without adequate knowledge of the huge operations required for enabling a modern army to live and move. Actually our army was shot on shore in the Crimea without baggage or transport.'[1] A supply system evolved at the beginning of the nineteenth century for mobile operations, and speeded up to Napoleon's exigent standards, produced no offspring fit to cope with even the static warfare of the Crimea. Among others, one reason undoubtedly was that, although British methods of supply towards the close of the Napoleonic wars became more efficient, its servants and their work were generally despised by the combatant, whose one remedy for failure was to suggest shooting or hanging the commissary. Between the ponderous niggardliness of the latter, the ignorant aloofness of the officer, and the distant financial control by a bureaucratic Treasury, little but friction was possible; and to make things worse, the commissary was a civilian and generally one engaged for the period of hostilities, whose social status was below that of the officer. Why should

[1] Kinglake: *Invasion of the Crimea.*

such a one, however able or interested, write of his work? And if he wrote, who would read? A few obscure diaries possibly survived, such as that of a commissary who served with the Hanoverian Brigade in the Peninsula,[1] but these were all. It is not then surprising that by the time of the Crimean War all that had been learnt of the art of maintaining armies in the field less than forty years before should have been lost or ignored.

History has a sorry trick of repeating itself. Will it so happen in some future war that swiftly speeding forces find their power stultified and their mobility strangled by supply systems which provisioned and munitioned armed millions, but mainly stationary and earth-bound, or at best able to crawl at three miles an hour?—a possibility, by no means unlikely. For it must be remembered that the latter half of the nineteenth century together with the period culminating in the Great War was an era in which the power of strategical movement was steadily and progressively diminishing; an era in which the growing size of armies was rendering strategy more and more subordinate to tactics. For long now, Mobility's wings have been clipped; nor will it be easy, despite all the reiteration of the modern slogan of 'Mobility, Mobility, Mobility', to change the mental outlook of the soldier, bred for more than half a century amidst traditions of elaborate detail, lengthy preparation, and cumbersome movement; nor for him to divest himself of the accustomed fetters of administrative tyranny. The problem of the future is a harder one than that which faced staffs in the Crimea: then, it was the scaling down of mobile methods practised in a previous war to the static conditions obtaining in the Crimea; now it will be the devising of systems of mobility from a background of past immobility. It is simpler to breed immobility from mobility than the opposite.

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[1] Schaumann: *On the Road with Wellington.*

What to-day are we doing in our rearward services to ensure that the combatant once again, as in an earlier age, be able to move distantly, independently, and daringly? Merely grafting on to new swift forms of force slow cumbersome systems which maintained the earth-bound hordes of the Great War, twenty years ago!—systems which have scarcely altered, although the combatant's means of locomotion has drastically changed. A comment made by Bernhardi, some years before the Great War, applies still more aptly to-day: 'If we only try to bring into line, more or less mechanically, the new phenomena of our time with the old views, we must resign all idea of mastering the situation and making the most of it to our own advantage.'[1]

How will mechanized forces, operating in conditions for which there is no precedent and which may only logically be surmised, be maintained in their endurance and with no loss to their inherent powers of mobility? That is our problem, and it is not the easier for its solution, hinging, as it does, on many a query at present unanswered, such as:

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[1] Von Bernhardi: *How Germany makes War.*

Will infantry retain its position as Queen of Battles? To what extent are the vehicle's powers of cross-country movement likely to improve?—and in consequence, strategical two-dimensional movement. To-day, the supply officer stands at a milestone in the history of war, and scans the road ahead anxiously: he has to visualize supply to a combatant now himself moving through the agency of new swift media—media of which the possibilities are as yet scarcely explored, and which can only grow with the years; whereas, in the past, freight train and supply lorry had little difficulty in overtaking and maintaining their marching or trench-bound consignees.

A weapon of the keenest is in the forging, but its temper will depend on supply, for supply—and we employ the term advisedly in its widest sense to denote the whole process from the initial receipt of all necessaries into administrative hands, and their transportation up to their ultimate issue to the combatant—represents the greatest of problems confronting staffs in the handling of mechanized forces. Its drab and awkward facts must be faced and a solution found, for it forms the basis on which rests the whole structure of war; it is the very foundation of Tactics and Strategy. It is a subject intimately affecting each and every branch of the Service, yet the combatant usually ignores this, deeming it a matter purely for staff or department. For him, two courses are open: he may acquiesce in letting matters lie, in the complacent hope that the next outbreak of hostilities will produce its own solution; or he may, by some study of the methods of modern industry and those of supply in the past, arrive at it. It is his necessities which govern supply.

Should he go for his needs to the Service libraries, he will quickly find there is little or nothing to assist him, for the works on supply, as a definite rounded-off branch of military study, may be counted on the fingers of one hand. They are astonishingly few. Mahan, in a preface to his classic, *Naval Strategy*, written in 1908, refers to an address given by him to students of the U.S. Naval College, Newport, in 1892, where he had stated that at that date 'a single one of the short book-shelves you can see downstairs contains all that we have to show on the subject of Naval Tactics'. As regards Naval Strategy the position must have been still worse, for he continues, 'in this remark I added nothing concerning Naval Strategy; for outside of occasional papers of the nature of magazine articles there was no formal treatise except Colomb's *Naval Warfare*, published in 1890'. Thus Mahan bewails the dearth of literature—and so late in time—on these important branches of study, and indicates his reason for the necessary formulation of principles, hitherto hidden in a maze of historical matter, or at the best but dimly and irregularly perceived. The situation depicted by Mahan has its exact counterpart to-day in the essential branch of military study which we designate as Supply, and the need of a generalized treatment is equally great.

The Necessity for Principles

War is the interplay of force-movement, displayed in many a different form. The soldier is accustomed for many reasons—the main one being unquestioning habit—to view it in its cavalcade of traditional and stereotyped units and formations, the Company, the Regiment, the Division, and so on. He is well aware also of certain warlike organisms to which he gives names, such as flank guard, main body, patrol, escort, convoy, and the like, of which each plays a specific part, more or less clearly defined. He goes further, and recognizes certain vague forms of force-movement in war, to which he allots such generic titles as raid, flying column, or self-contained force. The military reasons for them, or their purposes, he may possibly know; but there he stops. He seldom, if ever, questions the form which their supply may take, or seeks the reason.

Strategy and Tactics, in their art and practice, change slowly; but Supply, in its systems, much more so. For a system is invented, evolved, or adopted, and remains for so long the academically correct thing that it is never questioned, its efficiency is never doubted. It lasts for several generations; it grows old. Still, the soldier accepts it. Its immanence is too fixed; it is sacrosanct. We have, in the mechanized force, what may be termed a new element in warfare, but no theory or principles to assist us in assessing its values, or in best exploiting them; and so the best way to maintain it can only, failing extended and possibly costly experience, at the best be conjectural. The chemist, when similarly confronted with a new element, brings his atomic or other theory to bear on it, so establishing theoretically its likely behaviour or application under various conditions. So for the untried future and the changing present what do we need to assist us? Basic principles, fundamental ideas! But within our realm of supply do these exist? Seemingly not, for scarce a treatise exists which deals with the matter. Yet such fundamental conceptions must exist, underlying the varied supply systems employed in campaigns in the past, although history be so woefully deficient in all administrative detail. If so, then with such knowledge the soldier is the better equipped to devise others appropriate to the new and bewildering speed-warfare of the future.

Chapter Two

SUPPLY SYSTEMS

Analysis of Systems—The Nature of Bases—Carriage of the Soldier's Necessities—Mobility, the Test of Future Supply Systems

Analysis of Systems

In our study of past systems of supply we have to discover what kind they were, whether they succeeded or failed, and why. Such and such a system may have been employed unconsciously, being a matter of mere custom and tradition, as in the case of the enormous and cumbrous, loosely organized supply columns, in reality, travelling bazaars, which always accompanied native armies in the earlier days of British expansion in India. Or again, the system used may have been devised with all the perception of wise generalship to cope with a certain set of circumstances, such as confronted Wellington in the Peninsula, when he endeavoured to counter the mobility of his opponents' ragged looting armies by his admirable system of temporary depot-bases and agile mule transport trains. Or yet again, and more commonly, a system may have been employed for no other reason than that it followed orthodox doctrine and accepted practice. In its inception, it may have been a brilliant and successful piece of studied organization, eminently fitted to the military conditions obtaining; it may have filled pages of the text-books, till some rising genius relegated it to the limbo of the past, or it was discarded in the light of a new set of conditions, military, economical, or industrial, either singly or in combination. Such was the fate of the 'rolling magazine' system, which governed the tempo of the slow-moving operations in the pedantic warfare of the pre-Napoleonic era and was smashed by the French revolutionary armies. Such may be the impending fate of the present staging or *etappen* system, employed with little variation by the great powers to-day. For these reasons it is not enough to know that in a certain era, or on a certain occasion, a certain system was employed. We must ascertain why it was so used.

And here arises a difficulty: we seek a system and its principles, to find it wrapped up beneath vague labels—raid, flying column, and the like. There has been no clear division in the different systems of supply; no attempt at definition, based on principle; no clear thinking in the matter. To-day, the organizer of supply must deduce from a military past and the industrial present the principles of his craft. So, he must formulate his definitions, going far afield if necessary, for even war practice afloat or in the air may assist him; and always too, he must keep an eye glued to the civilian world of progress, where method and material change so quickly.

We will consider briefly in their customary aspect, as military activities, the following:

(*a*) the self-contained force,
(*b*) the force maintained by the staged system,
(*c*) the flying column, and
(*d*) the raid.

The first has always implied a large force, adequate to overcome any likely opposition, and amply equipped in itself for the specific purpose of arriving with a fair degree of certainty at its objective. Sir Donald Stewart's force, when he marched from Kandahar to Kabul in 1880, was an example. By the second term is understood that method by which an army moves, having its line of communications organized as a succession of administrative centres or points. A typical example of an advance supplied in this way was the invasion of France in 1870 by the German armies. The label 'flying column' has usually been attached to a small force, lightly equipped to carry out at speed a limited operation. The Boer War of 1899–1902 teems with examples of it. The raid, in its true sense, has been loosely used to designate a variety of operations, but marked in general by the characteristics of speed, stealth, and distance. The story of Lawrence's Arabs in Arabia during the Great War has many an example of this warlike manœuvre.

Let us now examine these same four kinds of force-movement in some detail, in the light of supply. But before doing so, we will dissect them with the scalpel of mobility. For our purpose, then, we will commence by taking a simple solitary traveller, setting out to trudge for some days across a strange country, safe generally for the odd wayfarer but for occasional risk here and there. While on his journey, he must (A) have food—his natural supply; and (B) be able to fight at need. So he will carry arms—his warlike supply.[1] The most vital of these primary necessities is food. Through it alone is Man enabled to go where he will, to wander as he please; it is his life, his agent of motivity, his fuel. His first and primordial fear must be that of starvation; and his second, attack by others.

(A)

How may our traveller obtain this food, while journeying? Two courses only are open to him:

(1) He may obtain food on the spot, either with or without payment; but this will depend on the resources of the countryside and the friendliness or otherwise of the natives. Nevertheless, our wayfarer, being neither hampered by having to carry his food, nor tied to any special supply route, may go as he please and as swiftly as he choose. Should he suffer attack, he meets it with no encumbrances.

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[1] The reader will here do well to appreciate the elementary difference between these two main forms of supply, so that he may be clear in a subject where even the expert tends to lose himself in its diffuseness. By 'natural supply' is implied the necessities of the soldier, *qua* man; by 'warlike supply', those of his superimposed needs, *qua* soldier.

and still does so with many. Their argument runs somewhat like this: 'Man—and the same applies to his domestic animal—wherever he goes, can glean his subsistence; he is a product of Nature's, and his simple needs may be gathered at her hands.' But the distance he can go, and the speed of his going, clearly depend on what he can pick up or carry. The great migrations by land in early times moved like this, but slowly and hardily. It was not till ships became large and their voyagings regular and certain, and till the railway with its great carrying capacity and speed arrived, that the ebb and flow of population, as we see it to-day, commenced. Both are machines of sorts, and their use made possible the peopling of great colonies and dominions with migrants from other lands. Again, viewing the matter on a smaller scale: can any animal, in its powers of progress-cum-subsistence vie with the modern motor vehicle in a trans-continental or trans-Saharan trip? Even the camel, well named 'The Ship of the Desert' for its powers of endurance and self-containment, and the Arab, who would—if we are to believe T. E. Lawrence—drink to the verge of vomiting before a long stage, must bow to the machine. An example of the weakness of man's domestic animal, as a transport medium for the needs of a modern army, is available in a calculation made shortly after the Afghan War of 1879 and based on the then scale of baggage for mountain warfare. In this it was estimated that to maintain an expeditionary force, 36,000 strong for fifteen days, on the frontier there would be required about 70,000 mules for all purposes, this number allowing for a percentage to replace unavoidable casualties.[1]

Let us return to our principles, and sum up. In force-movement in war, its supply may take a form embodying one of the following, either singly or in combination:

(*a*) Self-containment,
(*b*) Reduced Self-containment,
(*c*) Replenishment from the Rear, or
(*d*) Local Replenishment.

Here then, are principles of supply—basic ideas, embodied to appear as commonly known forms of force-movement: they are the diatheses of supply, though diagnosis may not always be simple. In its impedimenta, the flying column may approach more or less the self-contained army: thus, when Roberts marched in 1880 from Kabul to retrieve the Maiwand disaster, his force, although it had the true attributes of a flying column, was nevertheless large enough to be considered considerably more than the latter. The dividing line between the self-contained force and that maintained by the staged system may be difficult to perceive; as for instance in the earlier part of Napier's advance from Zula to Magdala, when he not only marched with a big bulk of accompanying stores, but also dotted strong points along his long line of communications to facilitate the forward movement of maintenance convoys. Again, local replenishment may be an adjunct of the other three principles; as it was in the case of the highly self-contained Napoleonic division; as it was in '66 and '70, when the Teutonic invaders resorted to the requisitioning of local supplies, in order to relieve the burden on their over-taxed *etappen* systems in rear of their armies; or as it was frequently in the Ashanti campaign, when small flying columns would subsist on half rations supplemented by what the 'bush' could yield. Each system may well appear as an adaptation or extension of another; yet, by the aid of these principles, thought may be held straight and canalized when studying problems of supply to mechanized forces.

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[1] Hensman: *The Afghan War, 1879–80.*

The Nature of Bases

All systems, again, when resolved into their elements, are seen to consist of a base and distribution from that base. A base is the source whence power and mobility, whence life itself and its expression in war, must spring; it furnishes the ration, forage, or fuel, which ensure movement, and also the wherewithal to fight. Yet it can be said, and with truth, that supply governs mobility in the degree of denial of its base and by the period of such denial. Or in other words: the less a force is compelled to rely on the services of its base, the freer it will be strategically. This principle appears startling and, at first sight, even ridiculous; but let us consider it. In the staged system our base is in rear, fixed, and with its supply route or line of communications joining the force to itself. The route is in effect an extension of the base—so, it will be remembered the Romans viewed their great military roads, for with them to build a road was *via munire*, to fortify it—and the more certain the links in the supply system on it, the more rigidly and powerfully it be organized, the more will the force it feeds depend upon it. Lengthen the stages and loosen the links till nightly supply become a matter of occasional replenishment by convoy, and the force has automatically to be more self-sufficing, and so more mobile.

In this system, we may in some sort view our supply route, linking base to force, as the umbilical cord joining mother to child before birth—and the analogy is none too distant to-day. The railway line and pipe line which joined the British Army before Gaza, in Palestine, in 1916, to a distant base in Egypt, and which fed and watered it across miles of desert, was an umbilical cord to cut which was to perish. The famous road from Massawa, the base-port on the Red Sea, to Asmara, 8,000 feet up on a mountainous plateau, which was built under the aegis of Marshal De Bono at the commencement of the Italian operations in Abyssinia in 1935, was another veritable umbilical cord; and the continuous traffic on it was a blood-stream which kept alive a quarter of a million men. The main roads and railways which maintained the trench-bound hordes on the Western Front in the Great War were similar umbilical cords of supply. In these examples, man-power and its necessarily colossal tonnages have been responsible; but it was the very necessity for these routes and their continuously flowing traffic, which automatically trammelled the mobility of the forces they served.

In the self-contained army, its base is the transported mass of war gear and supplies which moves with it and as part of it. Reduce this in size, and the force's mobility as a whole goes up, if only for a limited period; it assumes the attributes of the flying column. There are the same results as the 'hiker' obtains, who resolves to cut down an overheavy and ample pack of travelling comforts to a bare uncomfortable minimum. Let us illustrate the point on a larger scale. In 1887 Lockhart, who had been punishing Afridi and Orakzai with a force of two divisions centred round Maidan in the Tirah, some seventy miles from his base at Kohat on the Indian frontier, decided to evacuate these valleys by as speedy a march as possible in the direction of Peshawar. Hospitals were reduced, followers minimized, rations for a week only ordered, and transport cut. Each division marched as a form of flying column; although even so, so hampered were they by their animal transport over bad going and in face of a guerrilla enemy, that the best speed made was forty miles only in seven days.

The raid's base is continually a new one, and chosen wherever the force may please in the area it traverses. By completely abandoning its initial base and severing itself from successive areas of supply this form of force-movement attains the highest mobility; it is like our 'hiker', who, becoming more spartan, resolves to be encumbered with nothing and to get his needs where night or weariness may find him. In the harrying attacks on the Hedjaz Railway, which Lawrence and his far-raiding Arabs carried out so successfully over great distances in their deserts, every oasis there was a fresh base of supply, and every valley, boasting a pool of brackish water or dotted with scanty thorn, a new source of strength. The desert, in its few and meagre resources, furnished his adequate bases, material as well as moral.

The belly of the battleship, once port is left, becomes another base and now a moving one, which meets the demands of its personnel for warlike and natural supply while on the high seas. The torpedo-boat and the galley of the ancients, if viewed from the supply angle, approach the flying column; for by their size and nature they are more denied in victualling, and less long-lived from their initial base on land. Let us go a step further to nail down our point. Consider the haversack and the water-bottle of the soldier himself. What are they really but the immediate base whence he has his being, and whence his movement springs? The immediate bases giving life and movement to car and aeroplane are the petrol-tanks they carry with them.

It is usual to consider a base, generally some important town on coast or frontier, in its strategical rather than its supply sense; yet to the supply officer such a base is merely a source of supply, and war but a matter of movement and a base. In times of peace man's wants are brought by many a converging channel to his doorstep; in war, his many needs are collected at some base for his eventual use. It was his utilization of the base in its varying forms which partly ensured to Napoleon the amazing mobility of his armies. Over and over again, we see him enter a territory, vanquish an army, and plant his *dépôt*, *pivot*, or *centre d'opérations*, in some selected town and there collect his reserves of warlike and other stores. From there he would launch his forces to complete a conquest by the speed of their movement, and the genius with which they used each successive locality as a secondary and recurring base. With such ubiquitous supply methods strategy's pace had grown, and the French were able to benefit from the increase in the marching steps of their infantry of from 70 to 120 paces to the minute, and so bewilder their enemies by the unexpected speed and length of their marches.

In the middle of the nineteenth century it was held that, owing to its complex wants, no force greater than a division could operate at more than 100 to 200 miles from its base, unless maintained by river or rail.[1] And when it is realized that at this time tents were carried in the regimental transport of the British Army, it would seem that this estimate was decidedly optimistic, and that military thought had already travelled far from the ideals of mobility held by the armies of the Revolution. Later in 1912, we find a French writer stating that, for the army of his time, maintenance could not be efficiently carried out from a base or railhead more than sixty or seventy miles away.[1] Even in the 'classic' Palestine campaigns, to say nothing of the less mobile operations in other theatres of the Great War, we seldom find infantry forces able to operate at distances even as little as these. Periodically indeed, operations were held up in order to enable the railway, then being built in Palestine, to catch up and so allow of the troops being within feedable distance of it. Ludendorf, Chief of Staff of the German armies in the Great War, has recorded his opinion that seventy-five miles from railhead represents the maximum distance at which modern man-power armies can be maintained, even with the aid of mechanical transport and its large carrying capacity.[2] To-day, our organization of the two M.T. supply echelons in front of railhead is calculated to allow of maintenance without undue strain up to approximately fifty miles.

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[1] See Wolseley: *The Soldier's Pocket Book.*

The railway has undoubtedly given mobility to the horde army; but, be it noted, a mobility of which the direction and distance are definitely restricted by its iron track. Real freedom of manœuvre exists only beyond railhead and, as we have seen, this, as a distance over which maintenance can be exercised, is steadily dwindling. The modern strategical lay-out can be likened to a man's arm, which has been pinned down from the shoulders (the base) up to the wrist (the railhead), where only the fingers have free play. It is interesting to recall, by way of comparison, that many years before Christ Alexander the Great was able to move a great army some twenty thousand miles, and to maintain it; and that, more than a hundred years ago, Napoleon was able to reach Moscow in the heart of the Russian wastes with a force of some 155,000 men—and there were no railways in those times.

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[1] See Colin: *Les Transformations de la guerre.*

[2] See Ragueneau: *Stratégie des transports et des ravitaillements.*

Since the beginning of the nineteenth century the mobility of armies has clearly diminished, and increasingly too. The Napoleonic ideal has seemingly perished. To-day, when the face of war, and the means of waging it, are changing so radically, a comparative study of the art of the great captains must prove of infinitely more value than that of the detail of some recent campaign.

The Carriage of the Soldier's Necessities and the Distribution of their Load

Having dealt with the base of the supply system, we will now turn to the allied problem of the carriage of the soldier's necessities, as this affects firstly the soldier himself, and secondly his main battle formation.[1] Dependent on his own legs or those of his mount, the soldier may lose mobility in one of two ways: he may be so heavily laden himself that his tactical value in battle is considerably reduced; or the transport accompanying his unit or formation may be so large and unwieldy that his strategical mobility as a whole suffers. So, in a word, mobility depends on the load placed on the soldier, or borne by his transport. In heavy man-power formations, the transference of even a few pounds from the combatant's back to his supply wagons entails a great addition to the accompanying non-combatant train. It is all a matter of distribution: tactical alertness, or strategical mobility; battle excellence, or the power of long-distance manœuvre. Here, are two conflicting claims. How have they been judged in the past? And how, to-day?

If ever a nation required of its armies strategical mobility to police the marches of an empire, that nation was Rome. On the marching powers of the legion rested the Pax Romana. Such were essential when, to ensure it within the pale of civilization or to keep the barbarian out, military traffic might have to move some 3,700 miles from its station at Jerusalem to guard the Wall of Antonine in Scotland, and when a standing army of 375,000 swords[2] held in law and subjection the whole of a civilized world. History records many a Roman march, such as that of Sempronius in the first Punic War, when his force marched from the extreme south of Italy to the north at an average of sixteen miles a day for a period of four weeks at least—a speed exceeding that of the Prussians in 1870, who on their long marches seldom exceeded an average of thirteen. Napoleon, a master of mobility—alone among the great European captains—managed consistently to approach in the speed of his armies that of the Roman. How did the legion manage these things?—for tactically, as an infantry formation, it was invincible: strategically, wonderful. Gibbon tells us: 'Besides their arms they were laden with their kitchen furniture, the instruments of fortification, and the provisions of many days.' The Roman was trained for weight-carrying, and this disciplined quality was so valued that the recruit, during his training, worked with arms and equipment 50 per cent heavier than those he would receive as a fully trained soldier.

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[1] i.e. formations such as the modern division, the Roman legion, or the Tartar *tuman.*

[2] The approximate strength of the imperial forces from A.D. 98 to A.D. 180. See Gibbon's *Decline and Fall of the Roman Empire.*

During the reforms in military equipment and organization effected by Marius, the great administrator, about the beginning of the first century B.C., the infantryman was called *impeditus*, and in derision *mulus Marianus*—the mule of Marius, on account of his heavy burden. This nevertheless endured throughout the great days of the Empire. Caesar's legionary bore a pack altogether heavier than that of the modern soldier, and as part of it actually carried as much as seventeen days' rations, while another thirty were relegated to the transport accompanying the legion.[1] Gibbon also relates how a tactical situation was met by the heavily burdened infantry: 'On the approach of an enemy they threw aside their baggage, and by easy and rapid evolutions converted the column of march into an order of battle.' By forcing the soldier to carry a considerable burden himself, and so keeping the accompanying transport to a minimum, the legion gained the power of distant movement and strategical independence for weeks at a time. The high ration-content of the soldier's load, and his self-containment as a whole, gave mobility. The Roman also valued very highly the qualities of hardness and frugality in a soldier; and the laws of the legion strictly forbade all but the necessities authorized in war. The cult of these qualities—attributes of the Roman virtue of *fortitudo*—was encouraged and practised, while Rome was great and her legions feared. Cicero in these words depicts the Roman soldier as a trained weight-carrier:

'You see now why we call our army *exercitus*: for full well does it know the meaning of exercise. Consider the strain of a route march, where the men carry more than a fortnight's rations together with a rampart stake, and all that they want for their use. As for shield, sword, and helmet, our soldiers count them no more as part of their load than they do their shoulders, arms, and hands. They say that a soldier's weapons are parts of his body, and they get so used to the feel of them that when the moment comes and they can throw down their burdens, they fight with their weapons unencumbered as though they were their limbs.'[1]

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[1] See Colin: *Les Transformations de la guerre.* Gibbon confirms these figures.

We have here the picture of a foot-soldier, alert in battle and yet prepared to be independent of others—a portrait very unlike that memory recalls of the infantryman of the Great War.

If we now note the load-distribution in the Napoleonic division, we will see it planned on much the same lines as those of the legion. In 1812 the men of the 'Grande Armée' walked to Moscow, carrying fifty-eight pounds each. Distances were immense, the country poor, and the troops kept themselves by a ruthless pillage of the countryside. In this there came off best the first corps of the force of 155,000 with which the incursion of ninety-three leagues to Moscow from Smolensk, its last base, was made. But what did its soldiers carry? The Count Philip de Ségur has fortunately left for posterity a detailed account:

'Each of their knapsacks, reduced to what was strictly necessary in point of apparel, contained two shirts, two pairs of shoes with nails, and a pair of extra soles, a pair of pantaloons, and half-gaiters of cloth; a few articles requisite to personal cleanliness, a bandage, and a quantity of lint, and sixty cartridges. In the two sides were placed four biscuits of sixteen ounces each; under these, and at the bottom, was a long narrow linen bag, filled with ten pounds of flour. The whole knapsack and its contents, together with the straps and the hood, rolled up and fastened at top, weighed thirty-three pounds twelve ounces. Each soldier carried also a linen bag, slung in the form of a shoulder belt, containing two loaves of three pounds each. Thus with his sabre, his loaded knapsack, three flints, his turn-screw, his belt and musket, he had to carry fifty-eight pounds weight, and was provided with bread for four days, biscuit for four, flour for seven, and sixty rounds of ammunition. Behind were carriages laden with provisions for six days.'[1]

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[1] Cicero: *Tusculan Disputations*, II, 37.

So out of a total of fifty-eight pounds, thirty-eight represent warlike supply; and twenty natural supply. The soldier carried his food for fifteen days; while another six days' rations were in the accompanying transport. His armament, judged by modern standards, was light; but there was little need for it to be otherwise. At Borodino, one of the bloodiest battles in the history of mobile warfare, the French soldier had cause to fire an average of ten rounds only.

Local replenishment was in the same way fully exploited by the French armies in the Peninsular War, as the following incident reveals—one taken from the diary of a Hanoverian commissary with the British forces.[2] A French colonel of Chasseurs, captured by the British, had expressed surprise that his guard had offered him no food, in these words: 'Sacré Dieu, our men have as much meat, bread and wine, as they can possibly carry in their haversacks; but you beggars have nothing.' To this the diarist, as he says, 'pointed out to him somewhat resentfully that, unlike the French army, we English did not live on spoil and plunder, and that an English soldier could not therefore be expected to entertain a Chasseur colonel to a meal'.

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[1] Philip de Ségur: *Expedition to Russia.*

[2] Schaumann: *On the Road with Wellington.*

The French division equalled the legion in its mobility; it also copied it in its supply methods. In both, the high level in self-containment of the soldier was maintained by the loot of the countryside, which went into his pack. And hence the reduction in his accompanying transport, and the mobility resulting as a whole. By way of extreme contrast, let us note our own infantryman of some fifty years later. He packed a load of fifty-five pounds, in which were two days' rations only —those of the reserve and the current day; and in the transport accompanying his brigade and division there were a further two. He and his division had a maximum of four days' independence only. (To-day, the position is even worse.) Little power of strategical mobility—this! In battle he was heavily burdened, and yet all that the legion or the Napoleonic division had—its surpassing ability to rely on itself for long periods —is lacking. Was this better than Rome's legion had achieved? Napoleon was a student of her wars; and Lawrence, the one great exponent of mobility in the Great War, has confessed to a reading of Caesar and Xenophon as being of more benefit to him than Foch's *Principes de Guerre.*

The foot soldier's load in the past has varied between fifty and seventy pounds in weight—about a third of his own weight.[1] In our army it has remained for years in the region of fifty-five pounds, until the present time when a serious attempt is being made to reduce it considerably. Much of what he has been accustomed to bear is now to be carried in his regimental mechanized transport. So relieved of weight, he becomes agile alert, and able to give the best of his speed when needed; he approaches somewhat the ideal of the scout; and his arm becomes an infantry *d'élite.* So much for tactical alertness, for battle excellence!—it is in line with the Roman legionary who, according to Gibbon, threw aside his baggage to fight unencumbered. But how about strategical mobility?—for, by reducing his load, he is now less self-sufficing. This is to be compensated for by the carriage of part of his personal necessaries in his M.T. truck; but a vital link between the soldier and his truck is being forged; and he and his truck tend to become one whole, a species of new super-soldier. We see that modern M.T. truck and man together can attain the same result as that attained in the legion and in the Napoleonic division by the simple armament of their men coupled with the high ration-content of their load.

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[1] In the Peninsula the British soldier carried between 50 and 70 lb. The Prussian, who humbled Austria in 1866 and France in '70, bore 56 lb. At the time of the Crimean War in 1854, the Frenchman supported as much as 68 lb.; while his British ally was loaded with 64 lb. At the outbreak of hostilities in 1870, the French load was at times as much as 75 lb.

In the Great War, this question of the load became a prominent one. Shell holes, mud, water, and wired defences, all conspired to make progress difficult at a time when, in face of a devastating enemy fire, speed and bodily alertness were of the utmost importance. Yet, it was on these very occasions that the soldier's load rose at times even to as much as one hundred pounds. Here was an abuse of the supply principle of self-containment. In the years prior to the war, the gospel of the offensive and the virtues of mobility had been preached, and by the French in particular. Then came the war, and what do we see? The *poilu* weighted down with masses of equipment; yet his formation, as a whole, gains nothing by his being so. Instead, he is shackled to a supply route, along which flows his successive days' rations, which a hundred years before would have been in his pack. On the Western Front there was little strategical manœuvre; tactics overshadowed strategy. The soldier lived and worked for four years in the battle zone; yet when he actually had to attack, he was overladen. A principle in war, as old as time, was ignored. That the overloading of the attacking infantry was unavoidable is allowed; but a solution, even if a part one and on a small scale, arrived eventually in the supply tank, which, in its great carrying capacity, was able at times to relieve the infantry of a large part of their burdensome, though essential supplies.

The mobility of a formation may be strangled equally by a surfeit of necessities, as by their lack; whether this be in the guise of a mass of accompanying transport, or be supplied continuously from the rear. Thus, the regiment will plead that fresh meat and bread keep the soldier fitter than does a diet of bully beef and hard biscuit—and it is right; the military doctor will insist on the extra blanket per man, to meet the rigour of a winter—he is undoubtedly wise; or a mess president will seek to win praise by 'doing things well'—it keeps up morale. All, all of these desirable extras are right in themselves and, taken individually, are insignificant. Cumulatively, however, they mean a huge added burden, not only to the formation, but also to administration all down the long line of communications, in extra transport, shipping, labour, storage, and other things. And, above all, mobility is reduced. Are we not too prone to forget the general truism, as true in war as it is in peace, that many possessions are a shackle to freedom of action? Still, the soldier of civilization must have the necessities of his time and race, and it has been for him to determine whether he would himself go heavily burdened and with less transport to hamper him; or be lightly laden and with the irksome duty of moving slowly and cumbrously in formation. His opponent, the irregular or guerrilla, has no such problems: his wants are few; and he carries them on his person or mount; his poverty makes him self-sufficing, and in war he is mobile.

Napoleon laid down the first of all supply principles: 'An army marches on its belly.' This belly may best be conceived as the mass of supplies which accompanies it; but of this the soldier himself is the 'prime mover', and his accompanying transport but an assistant. And on the distribution of the load depends the mobility of the whole.

Mobility, the Test of Future Supply Systems

Mobility has been described as 'the power to manœuvre and act with rapidity', and noted as 'the chief means of effecting surprise'. It is also defined as 'the power to transfer force rapidly, and to maintain it in any desired theatre'.[1] The product of force and mobility is simply rapid force-movement;[2] and supply, considered in its widest aspect, is a necessary concomitant of these two factors.

Mobility is the prized essence of the art of war, and to those who, like a Napoleon or a Genghiz Khan, have successfully sought it, has been given a full measure of victory, for it has made them the masters of surprise. So in the organization of a force the suitability of its supply system is of the first importance; for on its efficiency the mobility of the force must chiefly depend. There can be little doubt that it was the form which supply took in the different eras of the past that determined the tempo of operations, as any comparison of the wars waged by Hannibal, Gustavus Adolphus, Napoleon, and Foch will show. Hence mobility, the very *raison d'être* of the mechanized force, will be considered in its relation to supply; and in judging the possible adoption or adaptation of any supply system to be used the mobility attainable will, and must, govern the selection made. Nor must it be overlooked that its definition distinctly couples 'the power to transfer force rapidly' with the problem of 'maintenance'. Supply governs mobility, yet should never be allowed so to dominate strategy that it weakens the will of a commander to move. To his strategic purpose all else must be subservient. The supply system should be so prepared, so supple, that his intention based on the powers of his troops need never be emasculated, never made hesitant. An ideal!—yet one to be striven for. Just so, a wife may assist, and even govern, her husband's business; but should never dominate it, else calamity intervenes.

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[1] See *F.S.R.*, vol. ii.

[2] The term will be expressly used in these pages for brevity and convenience.

The systems of supply employed in the past, and their underlying principles, will be discussed in further detail in the following chapters: there will be shown the conditions which called for their employment; the advantages or disadvantages of each; and the use or abuse of the system employed.

Chapter Three

PRINCIPLE OF SELF-CONTAINMENT

The Self-contained Force—The Napoleonic Division—Principle exemplified in some Campaigns—Exemplified at Sea

The Self-contained Force

The earliest and most primitive of warlike operations were those carried out, either as a completely self-contained movement of a whole tribal community, or as a raid by some of its members upon a neighbour. To gain better pasturage for its flocks, or fresh hunting grounds for its young men, the tribe would migrate as a whole and at need battle to achieve these ends. History holds many a classic example of the first of these two types of warfare. We may read in Holy Writ of how 'the children of Israel journeyed from Rameses to Succoth, about six hundred thousand on foot that were men, beside children', when they came out of the land of Egypt, a tribe complete with 'flocks and herds, even very much cattle', and 'such things as they required';[1] and of how battle secured to them the fruits of the earth and on occasion also weapons from the vanquished.

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[1] Exodus, xii, 37.

The Roman was probably the greatest roadmaker the world has seen. His military roads facilitated supply from the rear; but his strategical movement rested in the main upon a supply system, embodying the principle of self-containment firstly, and local replenishment secondly and as an auxiliary. That war must support war was a maxim of Roman state-craft; and a general, from the moment he first set foot on enemy soil was not only expected to supply his troops from its resources, but to supply them well. For on his ability in doing so, and in also stripping it of some part of its wealth to add to that in the coffers of the Republic, would lie in some measure his reputation. It was the practice of the foregoing principles which enabled Julius Caesar to enter Gaul and, far from his home bases, strike right and left till he had made it a Roman conquest. As a general rule, the historian, ancient as well as modern, devotes little time and allots but the scantiest of lines to matters of supply, save where there has been censure or failure. Then, this excuse is invariably recorded. Yet history records no operation in a Roman campaign entirely stopped by difficulties of provisioning. Modern history on the other hand teems with them.

After the collapse of the Roman Empire, the art of war decayed and sank to oblivion, as did many of the arts of peace. But the idea of the force equipped and then launched to conquer an enemy and feed at his expense persisted—the principle is logical. Let us commence with the sixteenth century. In Europe then roads were few and very bad; armies marched in heavy columns, as they permitted; and, judged by modern standards, they would have been considered armed mobs. Their baggage columns were enormous, as also were the masses of non-combatants which accompanied the troops. Thus 'in one of the German armies in which the troops did not number more than 40,000 there were counted 140,000 camp followers'.[1] And there was little of military method in the provisioning. When necessary, the country was stripped, and the plunder carried in carts accompanying the force. Gunpowder had come in, and its armament was heavy and cumbersome; and this further assisted to make warfare a matter of slow marches and many sieges. Of mobility, there was none.

The revival in war's art came with the first of the great modern captains, Gustavus Adolphus of Sweden. He substituted mobility for weight, as the primary desideratum in war; and he achieved this in the main by systematizing his supply methods. He arranged for the installation of magazines at carefully chosen strategical points, and then stocked them, either from the homeland, or by enforced, though paid for, contributions from the country traversed. A regular staff of commissaries served his forces, which at a maximum never reached a total of 200,000 men, and sutlers were authorized to minister to their needs. Baggage columns—the curse of strategical mobility in the sixteenth, seventeenth, and eighteenth centuries—were cut down and standardized, although they still remained large. These columns were really rolling magazines, and embodied in their employment the supply principle of self-containment, aided by that of local replenishment as an auxiliary; they were both the pack and the belly of the army. His methods differed from those of his enemies, who ravaged the countryside for their supplies, while he made a practice of paying for what he took. Through their discipline, frugality, and organized supply systems, he made his un-uniformed[1] peasant forces mobile; they could manœuvre and march. In their campaigning they covered a territory stretching from the Baltic to the Alps; and one of them, 20,000 strong, was able to march over bad roads some 270 miles from Donauwörth to Naumburg in eighteen days, or fifteen miles a day.[2] Here were supply principles embodied so that they ensured mobility—a mobility, not as the Roman had understood it or as Napoleon did later, but still much superior to that of any other army of the time.

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[1] Furse: *Provisioning Armies in the Field.*

These were the principles underlying maintenance systems throughout the Thirty Years War; and they consisted in the collection to magazines, fixed or rolling, of local supplies obtained by purchase or plunder, combined, when possible, with billeting and individual provisioning by the inhabitants. Turenne and Wrangel practised them in their campaigns, but with the exception that, while Gustavus relied on fixed magazines stocked by requisition on payment, these later commanders, whose armies were smaller, lived on plunder from the nearest town. And mobility was still a feature of warfare. Turenne, for instance, in 1657 marched 30,000 men from the Scheldt-Sambre region to the Lys, seventy-five miles in three days, or twenty-five miles a day.

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[1] Uniform was first introduced in 1665 by Louis XIV for his Guards, and thereafter became general.

[2] Dodge: *Gustavus Adolphus*.

Standing armies became the fashion in the seventeenth century, and they reached their high-water mark in the reign of Louis XIV, when France could show a royal army of 200,000 men, and the other nations in proportion. The supply systems of Gustavus were imitated in letter, but not in spirit; and mobility steadily decreased. For this there were three main contributory causes, and in the first there was nothing new. European roads in general were still bad, and often had to be made to allow of the advance of the army's columns, and as a consequence operations seldom, if ever, took place in the winter. Again, armament had been steadily growing, and with it the detail and ritual of war—one has only to recall, in our own forces some decades later, the large drum which was solemnly borne and thumped on a ponderous four-wheeled carriage, so that dismounted artillerymen might march in unison. The mode of war grew in importance, as its vitality (or mobility) diminished. But the main cause was the increasing abuse of the existing supply principles. Supplies would be collected at some fortress-town, and from here flour and other stores would be transported two or three days' march to the troops. The flour would be baked in field-ovens there, or else on occasion six to nine days' supply of bread would be baked in the magazine and sent forward. The soldier himself carried three days' rations only on his person (but more than he carries to-day). Five days or so limited the march of the force from its magazine (to-day, a force is still more restricted in days of march from its base or railhead). Owing to this shackle imposed by a force's necessities in natural supply, and also to the great increase in armament and its importance, supply became overwhelmingly dominant (as it is to-day). It dominated strategy increasingly through a commander's anxiety over his communications and his magazines. An era set in of slow movement, strategical pedantry, sieges, and the attack or its threat on administration.

Louvois, war minister to Louis XIV, stereotyped the system of the rolling magazine, of which unfortunately very few details have been deemed worthy of record by military historians. He limited his forces to a five-days' march from their last fixed base, and from this the swollen magazine trundled along behind them, pinning them down with its cumbersomeness. Into it went the compulsory offerings of the surrounding countryside, of which the area of impoverishment grew wider as the length of the army's halt grew longer. The army was tied to its moving base: it was its escort. So had mobility decreased since the days of Gustavus. Still, the age was an agricultural one, armies were small, and success was occasionally achieved by the mere inertness of a greedy force within the marches of its foe.

Frederick the Great, perhaps the greatest exponent of the system, devoted the most meticulous care to the organization and safeguarding of his supplies, as witness the following instruction: 'This enjoins the greatest provenance, and even the employment of superfluous precautions, to safeguard your convoys, because, if you are vanquished by want, you are more thoroughly so than if you had lost a battle.'[1] He has left a description of his method in tabloid form, thus: 'Besides the vehicles which cart five day's bread supply in rear of the regiments, the Commissariat has its special wagons, and all this transport taken together can draw a month's provisions for the army.' Nevertheless, it remained a monstrosity—we have only to think of the well-known retreat made by him through Bohemia after the siege of Olmütz in 1758, when half his army was broken into small parts to escort a convoy of 4,000 wagons. The system, as then employed, heavily dominated a commander and his will to move, but it was employed in all European armies. A supply system which in an ancient civilization, and a century earlier—if judged by its underlying principles—had ensured freedom of manœuvre was now producing the reverse; with the course of time, the system had become rigid and the principles abused. As a heavy blight supply descended on the art of war, and a general lethargy in its conduct ensued, resulting in slow marches, constant sieges, attrition of the warring countries' resources, and prolonged campaigns. The sluggish unwieldy supply trains became the heart and soul of the business. Indeed, the attack or its threat on a base of supply whence the rolling magazine was replenished, or on the latter itself, constituted one of the most important operations in the eyes of the soldier of the day. The lack of mobility was the salient feature of this age (as it is to-day in the warfare of heavy man-power armies).

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[1] Frederick II: *Principes géneraux de la guerre.*

The Napoleonic Division, another Application of the Principle

This era of a sluggish pedantry in war coupled with a lack of real generalship drew to its close when the French Revolution broke out in 1789. How was it then that the mobility of Napoleon's armies, which confounded his enemies and startled the military world, sprang from so sluggish a background? Was there a link between the two eras? —or must we merely plead the genius of this great commander for sufficient reason? The point is of more than mere academic interest, as mobility and its supply systems are so intimately related.

Between the end of the Seven Years War and 1792 the writings of three officers, Du Teil, Bourcet, and Guibert, attracted a great deal of attention. Although aristocrats of the old régime, they were radically minded; and partly as a consequence of their views many reforms were carried out in the twenty years or so prior to the rise of Napoleon, which led to new ways of making war and a new organization, of which the most important measure was the introduction by the Comte de Saint-Germain of the divisional system, when he became minister of war in 1775. Napoleon, as a young officer and an ardent student of war, could not have failed to become acquainted with this literature—works such as Bourcet's *Principes de la guerre de montagnes* and Guibert's famous *Essai général de tactique.*[1] His study absorbed their theories, and his genius exploited them. Both Bourcet and Guibert had paid great attention to the matter of rearward services and supply, and the latter in his *Essai*, published in 1772, devotes a chapter to the subject. He advocates the organization of the army in permanent divisions; a return to mobility, such as the Roman legion had; the fullest utilization of local resources, as it had made; and the suppression of existing superfluous baggage trains. But let his words speak for him:

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[1] Spencer Wilkinson's thesis in his *The French Army before Napoleon* has here been closely followed.

'It is astonishing', he says, 'how much a good military administration can extract from the resources of a country. I speak of a populous and fertile country such as Flanders and the greater part of Germany. I am not exclusive or excessive in my opinions. I will not say to an army: "Have no supply trains, no magazines, no transport; always live on the country; advance if need be into the deserts of the Ukraine; Providence will feed you." I want an army to have provision wagons, but as few as possible, proportionate to its force, to the nature of the country in which it is to operate, and to the means required in ordinary operations. If it starts from a river or a frontier, let it have on this base magazines and depots well situated to their defence and the plan of operations. But if it is necessary to undertake a bold operation and forced marches, the army must be able to discard the precise methods of routine.' He continues further on: 'What I want to avoid is that my supplies should command me. It is in this case my movement that is the main thing; all the other combinations are accessory and I must try to make them subordinate to the movement.' Then, after outlining his vision of war waged by a nation in arms, as opposed to a small standing army, he concludes: 'Such a revolution can be brought about only by a change in the spirit and manners that now prevail. But to change the spirit and manners of a nation cannot be the work of a writer, whoever he may be. It can be that only of the sovereign or of a man of genius, into whose hands great misfortunes and the public voice, stronger than cabals, will place for a series of years the helm of the machine.'

Early in his career and long before his opponents, Napoleon had realized the increase in agriculture which had taken place, and the great development in the roads of Central Europe, where many had been metalled since the Seven Years War. He had foreseen that both these factors would permit the movement and subsistence of larger forces in the field. War was to support war, more than it had done in the past; and the countries traversed had to feed his armies over the wide areas they were spread. The introduction of the divisional system in the armies of the Revolution facilitated this. Napoleon's division was heavily self-contained, carrying as much as twenty-one days' rations, as has already been shown; and the loot of a countryside found its way into the soldier's pack or cart, to build up this self-containment. We see, by comparison with the cumbersome force of the pre-Napoleonic era, that now the soldier himself carries the bulk of what used to be in the accompanying train, his own transport has been cut down considerably, and he relies on the principle of local replenishment much more fully. The principle of self-containment, so exercised, now leads to mobility. The methods of a Napoleon spell mobility: those of a Soubise, the reverse. To the former, the collection of supplies to a magazine, or the dispersion of an army to gain its food and forage, were all the same; that system was used which best suited the occasion. In its general outline, however, the system and its principles were a reversion to that of the Roman legion.

The principles of self-containment and local replenishment, as applied in Napoleonic supply methods, persisted after the Napoleonic wars; for we get Clausewitz writing in 1832 thus: 'The subsistence of troops being a condition which is indispensable in the conduct of war, it has a great influence on the operations of the war, particularly in this way, that it will only allow of the concentration of troops to a certain degree.'[1] This latter difficulty had, however, been met by the organization of armies into divisions and corps. It was considered practicable to maintain an army in this way for some time without recourse to a magazine, and particularly so as these formations contained their commissariat departments. Despite this, some reliance on magazines in the rear was also visualized. We find Clausewitz continuing: 'A wise commander, even if the resources of the province are quite sufficient, will not neglect to form magazines behind him as a provision against unforeseen events, so as to be able the more readily to concentrate his strength at certain points.' These principles formed the basis of supply systems in the field from the latter end of the eighteenth century until a new system was introduced for the maintenance of still greater armies in 1866.

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[1] Clausewitz: *On War*, vol. iii.

To continue, however, with the particular system we are considering. In the early wars which gradually spread British dominion in India, armies were self-contained in warlike supply, while the requirements in natural supply were met by what were in reality large bazaars, which accompanied the forces. Food and forage were easily collected in this rich country through the efforts of able native contractors; and so the supply column (or bazaar) was replenished, the slow tempo of operations permitting this leisurely haphazard method—in effect, once again the rolling magazine system of Louvois, with all its lack of mobility. The system in India lasted for many a generation, for later in the Mutiny of 1857 the accompanying transport of British armies still used to straggle along over five or six miles of road. There were times when complete self-containment in all supply had to be resorted to, as was done when the British invaded Mysore in 1799, most of the country ahead of the advancing force having been stripped by their opponents. Complete self-sufficement was thus forced on the invaders. Accordingly from Bangalore, as its jumping-off place, the force moved with an approximate strength of 40,000 combatants and four or five times that number of followers. In order to protect its train, and as an order of march, the force moved as a hollow square about three miles wide and seven long. Inside this went all the commissariat transport animals, 126,000 strong, and supplies calculated to last for the full estimated period of the operation. Such a force could by no flight of the imagination have been termed mobile, but fortunately its enemies were less so, and it reached Seringapatam, the capital of Hyder Ali, and stormed it.

The Principle Exemplified in some Campaigns

A tragic example of the abuse of the principle occurred in 1883 in the Sudan, where a Mahdi had set himself up in opposition to the Egyptian Government. To retrieve a bad situation, Hicks Pasha with 8,000 troops and a few guns was set afoot to march on El Obeid, from Duem on the White Nile over a desert barren of all supplies. Trained in a modern school, he had originally thought in terms of the prevalent staging system; but the Turkish Governor-General had asked him 'to abandon the idea of having this line of posts, to give up my line of communications, and line of retreat, and to advance with the army *en l'air* with fifty days' supply of food only, the Arabs closing in on our rear'.[1] This course was adopted, as it was anticipated that an L. of C. could not be kept open, working, and secure. A desire for more mobility, in the face of an extremely mobile enemy, had certainly not been one of the reasons for the course taken; for the distance traversed was 253 miles, at 13 to 14 miles a day with halts between marches averaging 2 or 3 days each. The time taken was 43 days. The enemy early commenced to harass the slowly moving unwieldy force, which finally with its large camel transport under ill control and with its ammunition down to but 240 rounds a man, headed for the prepared ambush near Shekan, where it was annihilated.

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[1] From Hicks's last letter. See Wingate: *Mahdiism and the Egyptian Sudan.*

Here was an example of the advance of an entirely self-contained force, in which mobility was not sought by cutting adrift from a base and an L. of C.; and yet it was launched—a force inadequate for its accompanying base.

Let us now turn to a similar type of supply operation, which, however, was crowned with success. On the 2nd of October 1879 a force under Roberts, consisting of 6,600 combatants, 6,000 followers, some guns, and 3,500 transport animals, advanced on Kabul from its base at Kushi. Speed was imperative; but the country was hostile and poor in resources; attacks were to be expected on the L. of C.; and winter would soon close the passes. So it was determined that the force should be self-contained by the carriage of the necessary warlike stores and also fourteen days' supplies, and be strong enough to overcome any likely resistance. In the words of an eye-witness, 'it was its own little world, self-contained and self-supporting'. It marched over the worst of roads through a country mountainous and desolate, and reached its objective on the 8th October. The long line of transport, though too little by half to do its work properly, was always difficult to protect.

What may be learnt in a supply review of this advance? Here we have a force which cuts adrift from base and L. of C. and though small and with no heavy fighting to hold it up, yet, owing to the cumbersomeness of its accompanying transport and the bad roads, covers the surprisingly small distance of thirty-eight miles in six days. If we apply as our test the mobility attained, it is clear that the supply system, though doubtless the best possible in the circumstances, made little contribution towards success.

As a study in fundamental principles, the operations of Von Lettow Vorbeck's Protective Force in East Africa in 1914–18 present many features of interest. When war broke out, the commander decided on guerrilla operations. He had a country of long distances, tropical and rich; a friendly, or at least obedient, population; a native force, lightly equipped, frugal and enduring, but small in numbers. Yet the improvised supply system, employed at first and for many months after, was that used by heavy man-power armies to-day. Steps were taken early to establish an *etappen* system with its base area in the northern end of the colony; and on this carriers in thousands worked in stages. It was still in force when the Germans were compelled to evacuate the north and retreat towards the heart of the colony. Here another similar system was instituted, this time with supply flowing northward from temporary bases; but this in its turn was threatened, and its depots formed key points for enemy action, besides tying the Germans to their supply routes. Difficulties grew worse, and to remedy matters the force was purged of the non-combatants it could not feed and the combatants it was unable to munition; it was thought to retain in the Rufigi country a small compact self-supporting force only.

But the retreat ever southwards had to continue, with a supply situation growing continually worse. So, in the commander's words, 'our eyes naturally turned to the Portuguese territory across the Rovuma'.[1] This was reported as very fertile, and so the border was crossed; but it was now a question of 'should we succeed in satisfying these requirements of the force which could not be obtained on the spot, especially ammunition and arms by means of capture from the enemy—for the only possibility of renewing our supplies lay in capturing the enemy's—in sufficient quantities to make the continuation of the war possible'. The conduct of the war now takes on a very different aspect. Note this force of 300 whites, 1,700 askaris, and 3,000 carriers, as it crosses the border. It is compact and self-contained; each soldier is fully armed and heavily laden; each carrier bears twenty-five kilograms; askaris' women accompany it, carrying their own property and that of their men; the whole marches at about nineteen miles a day—we have here the picture of a wandering, fighting tribe. At first it is self-contained in both warlike and natural supply; but gradually, to serve its needs of the latter, it lives by ravaging the local crops, while to replenish the former it assaults or captures the enemy's posts.

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[1] Lettow Vorbeck: *My Reminiscences of East Africa.*

In this brilliant campaign, where we have followed in outline the movements of the main body, the various principles of supply stand out, sometimes distinctly, sometimes overlapping. The desire for the greatest freedom of manœuvre was ever present in the mind of the commander: it was on the attainment of this his success would hinge. And we see it granted in increasing measure, as system follows system.

The Principle Exemplified at Sea

Self-containment, coupled with mobility, is well exemplified in the warship. Its port is its fixed base of supply, and once it sails, it abandons this and cuts its communications. These can exist only as imaginary lines, except in the case of certain confined waters, such as the English Channel, which of necessity restrict shipping routes. The ship is not confined to the one-dimensional movement imposed on the land force by road, rail, or inland waterway, when she is on the high seas. Her nearest analogy on land is the powerful self-contained force. She has great storage space for all she requires—in the days of sail this was particularly so—and frequent return to port for replenishment is not necessary. So it was that Nelson's storm-tossed squadrons were enabled to hold their ceaseless vigils off an enemy's coast for the long weary months they did. During the period 1803 to 1805 his ships were always self-contained to the extent of three months' water and provisions, and an even greater self-containment was aimed at. As Mahan says: 'Ships carry the substance of communications largely in their own bottoms.'[1]

The principle of self-containment may be subject to abuse at sea, as well as on land. Just as poor Hicks Pasha's force met its doom largely through an abuse of this principle, so similarly Rozhestvensky prepared for his in the Straits of Tsushima in the Russo-Japanese War. He had been warned that for his later maintenance in the war he was not to count on the poorly equipped port of Vladivostok. In consequence, his warships took on board coal and supplies in all the quantity they could—it is even related that coal was placed in the admiral's cabin. The fleet was also accompanied by four heavily laden auxiliary steamers, which could only still further embarrass and impede the fleet in battle. In the final action in the Straits, on the top of the difficulties due to the overladen ships and the accompanying cargo vessels, fires broke out which could only have been assisted by the mass of combustibles carried. To quote Mahan again: the Russian commander 'had become so obsessed with the question of supplies, and of reaching Vladivostok, that neither escape nor battle clearly dominated his mind'.

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[1] Mahan: *Naval Strategy.*

With the arrival of the aeroplane has also come a super-soldier. For the airman, tactically and strategically, machinery does everything. He personally has to carry nothing; yet at the same time the machine's power gives him enormous mobility in three dimensions; and at the cost of very little man-power a high destructive potential is assured him. His formation, self-contained in its supply for the period of its mission, once in the air abandons its fixed base and works with no line of communications in the literal sense; and, like the ship, the larger and more powerful aircraft grow, the greater will be its power of self-containment and the more independent its power of manœuvre. Again, like the ship, it has not to depend on muscular force, as land forces have had to do.

Chapter Four

PRINCIPLE OF REPLENISHMENT FROM THE REAR

The Force maintained by the Staged System—Origin of our Present Lines of Communications, 1866—*The Load on the Soldier's Back—Development of the System,* 1870—*The System fully Fledged,* 1914—*Its Logical Conclusion, Palestine,* 1916—*As a Unity of Command—The System to-day*

The Force maintained by the Staged System

The Napoleonic division and its supply system brought to a rapid close the long era of warfare in which armies at first used, and later abused, the principle of self-containment. Generalship, the art of manœuvre, and rapid decision by battle flew their colours again. But the times were peaceful. After the end of the Napoleonic wars there was a period of growing prosperity in Western Europe: industrialization had come in; and population increased by leaps and bounds. Armies grew in size, and 'the Nation in Arms' became an accepted convention. Nelson had said 'numbers annihilate'. And God marched with the big battalions.

In the railway, with its speed and carrying capacity, was discovered the major instrument for the maintenance of great armies. Its use made possible the operations conducted by the Prussians against Austria in 1866, when a new supply system, prepared and planned—the point is worthy of note—in years of peace, set a new fashion in Supply, pregnant with consequence to the future. It made possible the movement of armed masses in a way that startled military thought in Europe, and made the Prussian army a model to be copied by all. The system, in outline and principle, is still adhered to to-day.

Origin of our Present Lines of Communications—1866

The doctrines of Clausewitz were to affect warfare powerfully right up to the Great War. He preached 'absolute war'—the annihilation of the enemy's armies—and massed man-power driven forward ruthlessly by the overwhelming will to win; so that the weaker will and the lesser combinations of the enemy should be swept aside. He would have none of the pre-Revolutionary theories. To him, Napoleon had been 'the very god of war'; but he misread him and his success, seeing in him the incarnation of a nation's man-power driven by genius. He fastened on the moral values and the power of the organized mass. Such were his main deductions from the incomplete sources of information then available, his great treatise *On War* being published in 1832, only seventeen years after Waterloo. It was not, however, till the period 1858 to 1869 that Napoleon's correspondence was published; nor was it till 1888 that analysis revealed the sources of his inspiration and genius—in the writings of those pre-Revolutionary aristocratic radicals!

A school of thought had risen, powerfully swayed by the Clausewitz doctrines, and it was in harmony with their general principles that the new system of supply was devised: in front would be driven the great man-power masses on their pre-planned routes, to a cast-iron schedule; while behind these would flow uninterruptedly their following river of supply.

The origin of the system is revealed below in an extract from the Militär-Wöchenblatt of the 20th of November 1872:[1]

'Already during the campaign of 1866 a systematic ordering of the *Service des Étapes* behind the forces had seen the light of day. From the experience gained in this campaign sprang an instruction termed "The Organization of the Lines of Communication", which was approved by the King of Prussia on the 2nd of May 1867, and which was kept completely secret. This organization was put in practice in the war of 1870–1 against France, and so occasion was found to judge of its practical value. In general, it has been recognized that the organization was built up on a sound basis.'

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[1] The official organ of the Prussian staff. The translation following is from Pierron's *Stratégie et Grande Tactique.*

So here in '66, for the first time, was employed the *etappen* or staging system of supply, in which as the army advances, it drags behind itself a lengthening chain of magazines and bases each formed in succession as the working distance from the last supply point becomes too great for the continuously provisioning columns. Such a system bears little relation to those of the Napoleonic division, or of its era. But that was an interlude of genius; and it was not from its mobile systems that this later one was evolved. In the war of '66 it will be seen how, as a first step in development, the feeding transport—the rolling magazine of Louvois' time—lengthens out towards the rear; and how the bulk of natural supply up with the troops diminishes. These early Prussian architects of Supply discarded the accompanying unwieldy train of an earlier time, to replace it by columns replenishing in turn from the rear the troops they served. Here we see, beginning to be systematically exercised, the principle of a continuous replenishment from the rear.

For these reasons, the system in this campaign calls for some little study in its detail. Each *corps d'armée* was organized as a complete little army in itself, and in round numbers comprised 31,000 effectives. Its battalion transport was meagre, consisting of one wagon each for ammunition, hospital, treasury, and officers' baggage. No provisions were carried in the regimental transport; while the soldier himself only carried three days' iron rations. The first link in the supply chain was afforded by five provisioning columns, which followed each corps and consisted of thirty-two wagons each. These carried three days' accompanying rations, the principle being that as soon as the wagons bearing the first day's supply were depleted, they should return to the magazine in rear for replenishment and bring up the fourth day's food. In the meantime, the other wagons would have been emptied. Their only business was this replenishment from the rear, and only in food and forage.

For ammunition, the following was the system. Behind the corps there followed nine ammunition columns, each of thirty-three wagons. The whole mass was divided into two divisions, the principle being that supply would be effected by one division while the other was in rear replenishing from the reserve ammunition park. The latter was similarly divided into two divisions of 264 wagons each, and was normally sited one or two days behind the moving force. As a rule, it travelled by, and was based on, a following railway. As far as possible, other warlike supply moved by the railway and was sent up when needed by special transport. Priority in supply was thus ensured in food for the man, and in the wherewithal to fight —the primal necessities of the soldier.

As the armies advanced, magazines in succession were built up and filled, either by stocks from the homeland bases or by the collection locally of foodstuffs. The advance into Austria was rapid—it was a seven weeks' war—and its mobility hinged on the new supply system; but the system itself depended for its highest benefits on operations moving to a cast-iron plan. Whenever mobility was highest, however, when the troops out-marched their following supply, recourse was had to local replenishment from the resources of the countryside. Still owing to the numbers engaged, about two-thirds of the total supply had to be effected by replenishment from the rear over a long line of communications.[1]

The Load on the Soldier's Back

Every effort had been made to reduce the regimental transport and the load on the soldier's back; but although the soldier depended daily on his provisioning column and now carried only three days' rations, his load still remained at fifty-six pounds. The warlike equipment, judged by to-day's standards, was not heavy: the average rounds fired per man at the great battle of Königgrätz barely exceeded one, hardly any soldier firing more than ninety. At the end of the campaign it was thought that, now railways and improved roads existed as an aid to the soldier, it should be possible for him to be less heavily laden and so released for his proper functions, marching and fighting—a cast of thought which to-day has its exact parallel in that born of the advent of the lorry and its powerful carrying capacity. This was done, but solely to lighten the man's load. About this time General Sherman was saying much the same, but with quite a different view:

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[1] This term is advisedly used loosely in these pages.

'I do not believe a soldier should be loaded down too much, but, including his clothing, arms, and equipment, he can carry about fifty pounds without impairing his health and activity. A simple calculation will show that by such a distribution a corps will thus carry the equivalent of five hundred wagon loads—an immense relief to the trains.'[1]

Here, he was thinking in terms of the strategical mobility of the formation as a whole, as did Rome's legion of old, and Napoleon also. In actual fact, notwithstanding many a committee, many a pious hope, has any material reduction in the soldier's load ever been permanently effected? Or been possible? The continuous growth in warlike supply must nullify any permanence of effort in this direction.

The Development of the System—1870

In the next European war, four years later, still greater masses are set in motion; the staging system develops; the links in the chain of supply increase, and are more accentuated; the columns of troops and supplies lengthen on the road; the railway bears a more continuously running freight; Supply, and particularly natural supply, lengthens out still more towards the rear and its centre of gravity moves farther back. Lines of communications are no longer seen as long lines of road and railway, as in '66, but rather as a zone, in which a network of roads and railways, dotted with supply installations of all kinds, bears supply unceasingly forward to its battle-edge. As numbers go up too, the benefit derived from utilizing local resources diminishes, and so the test of the system is severer and its excellencies and weaknesses more apparent.

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[1] Sherman: *Memoirs of General W. T. Sherman.*

At first, the railways were occupied to capacity in carrying the combatants forward, and so their supply had to move, as best it might, by road. By the time fighting had commenced, many corps were still without their provisioning columns. In this may be seen already a sign of the difficulties in moving, even by railway, modern mass armies and also their supplies. Once over the frontier the pace of the advance, the long length of the columns, and the difficulties in effecting supply forward by road and railway compelled a resort to local replenishment. This, though exploited with the greatest rigour, failed nevertheless to provide for more than one-third of the armies' total requirements, the balance having to be forwarded over the long supply routes from the homeland bases. About a day's march behind the advancing force came the *etappen* staffs organizing the L. of C. from its bases in rear to its ultimate railheads. (Already the latter was looked upon as a complete command in itself, as a unity for control.) And it was on much the same system as that used in '66.

In the day's march how was the bulk of supply for the corps, which itself stretched over twenty-one miles of road, distributed along a route filled with marching men and vehicles? Where lay the centre of gravity of its function? During the campaign each soldier carried three days' iron rations, a total of three kilos in weight. At first, no rations were carried in the regimental transport, as this had not been found necessary in the previous campaign; but it was found that the provisioning columns could not always get forward to effect supply in the evening. So in September 1870 local vehicles were requisitioned to provide a scale of two per regiment. Away in rear of these followed the supply columns (*Proviant-Kolonnen*) working pendulum-fashion between the troops and the last magazine, and carrying four days' rations. Behind these again, to be put in as additional echelons at need, followed the reserve supply columns (*Führpark-Kolonnen*), containing another four days' rations. The unit could thus rely on thirteen days' food and six of forage, somewhere with it or behind it. It will be seen by a comparison with the system of the 'rolling magazine' perfected by Louvois, and the *etappen* system in its early beginnings in the Austro-Prussian War, how Supply now spreads its function along the L. of C. and becomes a stream of maintenance from the rear.

In the short period available since 1866 the Prussians had improved the fighting power of their troops. The soldier's knapsack was now in the transport behind him, so allowing him greater freedom on the march; but no tents, waterproof sheets, or blankets, were carried by him or by his transport for him. He still carries three days' food for emergencies, and his ration arrives nightly. But has his load decreased? From the accounts available, the picture of him marching, complete with jack-boots, pickelhaube, and the needle-gun of '66 with its seventy-two rounds, is never one of alert agility, but rather of forceful, plodding weight.

The system proved efficient; but it must be remembered that the enemy's inefficiency in supply made an excellent foil for it. Further, the original plan of campaign was never seriously disturbed, as happened later in 1914 at the Battle of the Marne. The German plans of invasion in '66, '70, and 1914 had this in common: they were based on the guiding principle that the will to advance and the force employed, where decision was hoped for, should both be made so overwhelming as to brush opposition aside.[1]

Moltke's idea in his preparation for the campaign of 1870 was that invasion should be planned to conquer the enemy at once in the first battle, as was indicated in a secret memorandum to his military leaders on the 7th of May 1870 which pointed to a battle on the Upper Saar as his primary purpose. The following, taken from an official publication[1] dealing with the opening phase of the Great War on the Western Front, further illustrates the Teutonic conception: 'The German plan on the other hand was definite and worked out in the minutest detail. It was based on the Schlieffen plan of 1905, which was a gigantic wheel, pivoting on the left, with its preponderating force on the right.' The plan and the enormous weight behind it was to disintegrate the less solid and forceful plans of the enemy; but the movement of the gigantic masses must go according to plan. An advance planned in such a way and carried out successfully, even in its opening phases only, undoubtedly lends itself to the meticulous, staging system of supply. But should the speed of the advance be unduly increased or the necessity arise for a change in its L. of C., the system by its very exactness and cumbrousness must tend to dislocation.

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[1] The teachings of Clausewitz carried then, as in 1914, tremendous weight.

The adoption by modern armies of this system has made the operation of changing a line of communications one vastly more delicate than it was in the mobile warfare of the Napoleonic era. Then, even when armies lived very much more by requisition from the countryside and relied much less on their bases, we find Napoleon writing to his brother, King Joseph: 'L'art militaire est un art qui a des principes qu'il n'est jamais permis de violer. Changer sa ligne d'opérations est une opération de génie; la perdre est une opération tellement grave, qu'elle rend criminel le général qui s'en rend coupable.'[1] In the modern line of communications, stretching away from the force to its base, the system is so meticulously organized, so concrete a whole, and so intimately interlocked with the force it serves, that any separation of the formation from its own particular administrative services, from its particular sources of supply, and from its predetermined and particular needs, must spell dislocation in its movement, and may mean disaster. This was thoroughly understood by Prussian staffs in 1870. In the earlier part of the advance on Paris the Army of the Meuse was on the right of the front of invasion, while the Third Army was advancing on its left. At the siege of Sedan these relative positions had become reversed. After its fall, and before the advance towards Paris was continued, it was found necessary for these two armies to resume their original and relative positions, one to the other, owing to difficulties of administration and supply, the maintenance system on one supply route being unable to meet adequately the needs of the force originally administered by the other. In consequence, the Third Army had to march south-west and cross the line of advance of the other army, to take up the desired position. So tied were armies, even then, to supply routes organized on the staging system! Again, in 1914, owing to the enemy's successful advance towards the line of the Marne, and the great wheel of their right-wing forces which threatened the Channel ports and hence the British bases of supply, a decision was actually taken to change these bases from the Channel to the Bay of Biscay. Some slight idea of the difficulties attending the operation may be obtained from a study of the Ordnance history of the period. If, however, a similar undertaking had ever been necessary in 1918, when lines of communication had become a vast rearward administrative area, and when its static tonnages had become colossal, nothing short of an earthquake would have effected it.

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[1] Battle of Le Cateau, 26th of August 1914. *Tour of the Battlefield.*

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[1] From a letter written at Châlons-sur-Marne on the 22nd of September 1808.

In 1870, when the German forces, whose speed seldom averaged more than ten miles a day for a fortnight at a time, outran their following supply and got out of touch with their feeding railway, the problem of provisioning always became acute. In the latter part of this year one railway system was feeding the investing forces round Paris; and there were continual difficulties in supplying the troops from its railheads owing to the inadequacy of the horse-transport columns, large though these were. The convoys while on the move, covering distances as much as ten days out and back from railhead, would on occasion consume half their load. At the siege of Metz similar difficulties occurred.

In general, however, the methodical and sustained advance of the German armies, and the successful maintenance of the large masses of invasion, greatly impressed military circles in Europe. Towards this achievement more eyes were turned than in a direction where considerably greater achievement was in progress—the world of civilian industry, mechanical improvement, and inventive genius. Mass armies caught the eye rather than mass-production; quantity in flesh rather than quality in material; numbers rather than their replacement by machine power. Military force was read in horde armies. But not everywhere. Here and there, those of independent vision doubted whether the armed horde could be mobile, or be maintained, should its numbers continue to grow. Of such was Bernhardi, whose military works in the years before the Great War startled the Entente powers. The difficulties were also appreciated in French military circles. About the year 1887 the French soldier was to carry three days' reserve rations on his person, and two more were to be in his regimental transport. Each army corps was to have attached to it an administrative convoy in two parts, of which the first would carry four days' rations and the second additional rations in the shape of compressed flour, oats, and hay. To supply each corps it was considered that in front of railhead 1,000 vehicles would be necessary, of which 400 would be required to replenish from railhead the corps' accompanying train, and 600 for installing magazines between railhead and the troops.

It was acknowledged that, if speed were essential, the supply columns moving in rear could not possibly catch up to effect maintenance; and should the eventuality occur—a bad one, incidentally, for the supply services—of success in battle followed by pursuit, then the best the theorists could put forward was subsistence on the local resources under the fatherly care of the regimental officer. Modern transport media, the railway and the mechanical vehicle, undoubtedly facilitate supply from the rear, but their ultimate effect is to tie the marching masses still more firmly to their supply routes; and the operative superiority of one force over another depends on its marching power, the length of its columns, and the smooth and quick working of supply. In brief, the less a force is able to subsist on local resources the less mobile it is. This seems the verdict of history.

The System fully fledged—1914

In the summer of 1914, the European powers flew to arms; their democracies, swollen with wealth and man-power, lined up in two hostile camps; and staffs, trained in the methods of 1866 and '70, set to work to handle and maintain the growing masses in a warfare in which numbers achieved their apotheosis. To maintain the latter, railway systems were driven to capacity, the world was swept for horseflesh, and the young motor industry was impressed to serve military needs.

The earlier operations on the Western Front showed in many ways as enormously swollen replicas of those in '66 and '70; but in no phase of activity is this more apparent than in that of supply. The Germans' plan was based on a rapid invasion of France, after which, if success ensued, their main effort would be directed against their eastern neighbour. In their invasion of France, their right wing, approximating half a million men, was to sweep through Belgium, and press on south of Paris to roll the French up against Switzerland. Massed man and gun-power, sheer weight and numbers, driven ruthlessly forward was to cut a swathe of advance through any opposition; while behind, the elaborate staging system of supply could suffer little or no interruption, and so in its protected routine would cater for the huge moving masses on predetermined routes, as had happened in the previous campaigns. But towards the end of August, Von Kluck's army in pursuit of the shattered left of the Allies outran its supply, and his troops, hard driven and hungry, were in ill plight to stand up to the shock of the large French reserves and the British, thrown against them in the Battle of the Marne.

Within a short time static warfare set in, and the opposing trenches stretched from the Channel to the Jura. Behind each of these great trench systems, with their earth-bound populations, there came into being a vast administrative area, in which the routine of supply took on the aspect of permanency: administrative functions as necessary to man in war as they are in peace—provisioning, healing, repair, storage, recreation, and the like—came to a state of regularized efficiency; and transport, in a routine guaranteed by the impregnability of the trench systems, ran to schedule, ministering to consignees located for long periods in one place. Amidst such colossal immobility little can be learnt to assist us in viewing a future of mechanized warfare.

The System brought to its Logical Conclusion, Palestine—1916

Many a time invasion has flowed from Egypt across the deserts into Palestine, and the armies of the ancients were great in numbers. Self-containment must have then been the supply principle practised. Yet in the modern British campaign we find again the principle of replenishment from the rear embodied in the long line of communications, linking up the large base at Kantara on the Suez Canal with the forces 150 miles away, near Gaza. How was maintenance effected there? And how still farther up to Aleppo and Damascus?

The natural supplies of water existing in the early part of the advance to Gaza were totally inadequate for the large forces engaged, and the Suez Canal zone not only was their base area of general supply, but its Sweet Water Canal actually became their distant water base, from where a pipeline of a foot diameter was constructed to bring water to them. Water in ample quantity is a form of supply particularly essential to large man-power, and more so even to large animal-power, forces; and water bases governed all advances in this campaign. Examples are many where operations were held up on account of its lack, either absolute, or relative to the man-power engaged. It not only dominated operations, but also the size and composition of the forces engaged in them. Other forms of supply were catered for by the construction of a standard broad-gauge railway line from Kantara, which was started at the end of February 1916. This line crept forward at an average rate of fifteen miles a month, and its construction governed the speed and mobility of the advance. Supply through its transport medium—the only one able to cope with the needs of a modern horde army—dominated the soldier's will and power to move, even if only at Nature's pace of three miles an hour. Here, in railway and pipeline, is an excellent example of the principle of replenishment from the rear, embodied in its fullest and most continuous form; one in which the flow of maintenance forward practically becomes unceasing.

As the broad-gauge went forward, railheads were formed at suitable points, such as El Arisch and Rafa, and later Karm and Deir-el-Belah behind Gaza. From these animal or mechanical transport, working to the troops, formed the next link in the system, fantassi-carrying camel convoys distributing the water brought by the pipeline. The difficulties of supply to a large force in such a terrain are, however, strikingly exemplified in the First Battle of Gaza—even at a distance of as little as twenty-five miles from railhead. Railhead had advanced as far as Rafa, and there all available transport was mobilized to ensure the maintenance of three foot and two mounted divisions for the advance on Gaza. Its attack had been decided on, the intention being that, if successful, supply would come in by sea to Gaza; while water in sufficient quantity would be found there. If unsuccessful, then the force must fall back upon its precious railhead. The attack did fail, and the force fell back; but it is noteworthy how a modern force of heavy man-power was limited by difficulties in supply to a one-day operation, even though almost at the end of a railway.

The System as a Unity of Command

Since 1866 a new conception of the L. of C. as a concrete whole, as a definite organization, as almost a formation in itself, has arisen. At first there was a special *etappen* staff, headed by an

Inspector-General of Lines of Communication. Later, after the Franco-Prussian War, this staff was increased and perfected, and the senior officer had the sphere of his duties enlarged, becoming Inspector-General of Lines of Communication and Railways. His duties were to link up the armies with the Fatherland and be responsible for the maintenance of the forces engaged. In earlier eras there had always been control of some kind or other for certain branches of administration, for certain elements of supply; but now at last the huge tonnages of the horde army called for a line of communications which should be a unity under one command.

The Great War witnessed in our armies the appointment of a Director-General of Transportation, and an outbreak of hostilities would again see the creation of a Transportation Directorate.

The American Expeditionary Force, from its first landing in France up to the Armistice, failed to realize this one-ness of its lines of communication, and suffered consequently. It was not till nineteen months after America had entered the war that the status of her Transportation Service became that of an independent corps of the army. Circumstances had forced this, otherwise there would have been a crisis in supply. Even this unification of control was in some quarters not considered comprehensive enough. An American expert who had earlier suffered from the administrative confusion writes: 'There is indeed ground for the belief that all other means [i.e. other than rail and inland waterways] of transporting troops and supplies *en masse* by motor truck, aeroplane, etc., and therefore calling for co-ordination with rail and water carriers, should be incorporated in such an organization under a single head.'[1]

The System To-day

Let us now look at the product, in our forces, of this evolution—spread over a period of three-quarters of a century—of a system devised originally to meet the conditions of a war in 1866. The stages in our system, the links in our chain of supply, are all clear-cut, definite, and standardized. From the base runs daily a pack train, built up of the division's daily requirements of all kinds. It may be stopped for control at some regulating station and then proceed onwards, or go straight through to railhead. From here a Maintenance Company[2] (M.T.) carries supply forward to the next stage, Refilling Point, where the formation's Supply Company (M.T.) bears supply onward again to Delivery Point, near the troops. The normal supply situation on any one day would be as follows: on the soldier himself the emergency ration, and in his regimental transport the unconsumed portion of the current day's ration; and in rear, the Supply Company and the

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[1] Wilgus: *Transporting the A.E.F. in Western Europe, 1917–18.*

[2] Recently replaced by the Supply Column.

Maintenance Company will each be carrying forward another day's ration. So within reach of the soldier, or on the way, there are four days' rations. Ammunition follows the same stages, and in accordance with the principle that it must be passed systematically and automatically from rear to front to replace that expended in battle. Ammunition Company, Maintenance Company, and Ammunition Railhead, are its links in the chain of supply.

A glance at the foregoing will reveal to what an extent the development of the staging system has in the course of time relegated natural supply to the rear of the troops: how it is now no longer carried as so many days of strategical freedom, but remains as so many shackles to mobility in a process of continual flow from its distant base; how now with the formation there are but three days' rations, as compared with the twenty-one or so in the Napoleonic division or the still larger number which accompanied the legion; and how firmly welded to its supply route the army has become. Moreover, the soldier's ration has steadily increased, if not in actual weight at least in complexity. From a simple allowance in the Peninsular War of bread or biscuit, meat, and wine or spirits, it has risen to sixteen items, weighing about four pounds gross. But this by no means tells the full tale. For other and special scales have come into use for special purposes or occasions; and hospitals, canteens, coloured troops from many a country, labour of all sorts, and different conditions of terrain and climate, all add their quotas of difficulty to maintenance services. The luxuries of the past become the necessities of the present.

Warlike supply, which may roughly be considered as all supply other than water, food, forage, and cooking fuel, can be conveniently divided into stores which directly affect the soldier's power in fight, and those which minister to his well-being. His standard of comfort has gone up steadily: the waterproof sheet, the extra blanket, cardigan, gum boots, and many another item, all attest it. In the first category, the advance has been equally great. Each war sees a more efficient weapon, and with it a demand for the soldier to carry more ammunition. The steel helmet, entrenching tool, gas respirator, and automatic, have been other increases in personal armament. The soldier, putting jest aside, has become a Christmas tree hung with War's gifts; but he is endowed with a certain strength only, and can carry from fifty to seventy pounds only without detriment to his efficiency. As more warlike essentials are loaded on him, something must suffer. So his rations—his ability to move independently of anyone else—are taken off him. To-day, there remains but one complete ration still to be removed, should the process continue. He cannot even carry all his warlike needs, to say nothing of his food. Much of the former, such as the Light Automatic and the Vickers gun and their ammunition, is carried for him, involving the division of his immediate transport into two echelons, one containing essentials for battle and always remaining with him, and the other with less vital requirements being normally brigaded in rear.

The claims of warlike and natural supply have become conflicting, and the former has won: it forms to-day the select load which the soldier bears. But in so doing he, or rather his formation, has lost mobility, the prized essence of the Art of War, 'the power to transfer force rapidly, and to maintain it in any desired theatre'. Yet in war first must come the ability to move, and then the power to fight; and supply is to-day stultifying the first in its endeavour to increase the second. Here is the vicious circle, and one brought about by the fact that civilization's soldier can no longer bear the burdens necessary to an industrial civilization's war. Is this so strange a conclusion? In industry to-day could handicraft possibly compete with modern society's wants? The strength of the individual craftsman is too little; his output is too small. His day is finished, and the machine and its power have replaced him. The parallel is there. So where lies the remedy? Where the means to restore to the soldier his lost strategical freedom?

The dominance of supply is responsible for a lack of mobility in the conduct of war greater than that of the pre-Napoleonic era. Horde warfare, which has brought this to pass, has been assailed on humanitarian grounds for its insensate massacre; the horde has been indicted on the score of its defencelessness against gas; it has been attacked on the count of its impotence in the face of machine-gun fire; and now tardily follows supply, with the accumulated weight and logic of her dull, drab, and awkward facts, to show that as numbers grow so also must she grow, until at last, so far from being the agent of all that should enable the soldier to move and fight, she needs must make him less and less mobile. After the greatest battles in the greatest war the great armies of the Allies were unable to march on the capital of their defeated foe. Why? Because the masses deemed to be necessary in Berlin could not be maintained on the existing routes; for railway systems had been destroyed or become disorganized, and no other medium of transporting the masses and their supplies could be entertained. Here was supply dominating strategy at a most critical and vital moment.

To adjust the conflicting, and at present irreconcilable, claims of warlike and natural supply a super-soldier is necessary: one with the strength to carry all war's necessary burdens, not only armament to be powerful in fight, but also fuel and food to sustain the power of independent manœuvre; one to regain a lost mobility. Such only exists in the power-driven fighting vehicle.

Chapter Five

PRINCIPLE OF REDUCED SELF-CONTAINMENT

The Flying Column—The Horde's one Way to Mobility—Examples of its Use—Weakness of the System

The Flying Column

Mobility, as we have seen, is 'the power to transfer force rapidly, and to maintain it'. It has not been a conspicuous attribute of either the self-contained army or its successor, that maintained by replenishment from the rear. In both, its claims have been outweighed by those of armed power. What operations of speed then remain to a commander, amidst all the lack of mobility common to a warfare of masses? And what methods are allowed him by supply, whereby he may effect them? There are two, the flying column and the raid; and both are forms of force-movement in which armed might is sacrificed to speed, and assured supply to freedom of manœuvre. By their means in the past mobility has been obtained; but for the heavily equipped and cumbrously organized soldier of civilization the former has been the more appropriate and the more frequently used, and the latter but rarely.

The Horde Army's one Way to Mobility

The flying column has been the means employed by the slow-moving regular to compete with the speed of his irregular opponent, and his invariable counter to the swift raid operation of the native. In the normal way, it has been his very power of armament and complex organization which have, in themselves, tended to a loss in mobility, of which his lightly equipped and frugally provisioned adversary has taken full advantage. In small wars where such an enemy has been engaged, the difficulties facing a commander have been those of climate, distance, and supply, rather than those due to the enemy's opposition. More frequently than not, the force used has had to be limited in numbers—the main criterion of strength in the past—owing to difficulties connected with supply.

The term, flying column, appears to be of recent origin, and its conception as a special and mobile operation of war to have sprung out of the prevalent lack of mobility in war, particularly in the latter half of the nineteenth century. The idea of rapid force-movement, attained by a reduction in accompanying supplies, does not appear to have obtained earlier. The necessity had not then arisen. The very lack of mobility in great man-power armies would have been conducive to the devising of some special form of force for occasions when speed was necessary. It is hard, for instance, to conceive that among Genghiz Khan's far-reaching cavalries, able to cover as a routine their fifty to eighty miles a day, such a force would ever have been deemed necessary. In an army where all is mobile, such a conception is manifestly absurd. In our own army to-day it has a place, and its value is recognized. When, for example, it is impossible to carry out the daily replenishment of a force, this may be accompanied by an M.T. column specially organized to carry supplies for some days.

How is the flying column made mobile? All that the combatant himself can do is to ensure that a higher speed is gained through the forced march or the substitution of mounted for dismounted men. Viewed in the light of supply, it is the embodiment of the principle of reduced self-containment; for to gain mobility, rations, forage, and armament are cut to a minimum to last the period in which it is estimated that the task allotted will be completed. They may even on occasion be less than this bare minimum, when it is anticipated that local resources will supplement them. In that event, the operation would also partake of the nature of a raid, so embodying the principle of local replenishment as well as that of reduced self-containment. Always, however, the object in view is to reduce the bulk of its accompanying transport, and so make it freer to move and strike where it will. It is a small and agile brother of the self-contained army; but should its accompanying base of supply not be cut down ruthlessly, then it approaches the latter in its characteristics, and suffers accordingly. Still primarily, like the other, it gains strategical freedom by abandoning its base in rear and having no lines of communications.

Some Examples of its Use

Release from the slow advance of an army, tied by the shackles of a staged supply system, has often been obtained through the flying column. To take an example. In 1895 a French expedition landed in Madagascar, with the intention of marching on the capital of the Hovas, Antananarivo, 230 miles away. A force of 15,000 men was employed, and at first it was decided to build a road fit for staging up supplies in wheeled carts, of which 5,000 were available. But difficulties set in, and the advance became slower and slower. Finally, after 130 miles had been so covered, it was determined that a flying column of 4,000 men with an accompanying transport of 2,800 pack animals should push on. This was done, the remaining 100 miles were covered rapidly, and the capital was captured. In the above we may see clearly exemplified the practice of two supply principles in succession;

and through the use of the second, the release from an initial immobility.

During the Afghan War of 1879–80 Roberts's force was in Kabul when news was received of the Maiwand disaster. Orders also came for him to relieve the British invested in Kandahar. A fast march was essential, one to culminate in a quick, hard blow; and to effect this the force employed would have to be in reality a flying column. Moreover, its march would be in a direction such that every mile would be farther from the bases of Peshawar or the Kurram. Yet, in Sir Donald Stewart's own words, 'he never hesitated to send him [Roberts] adrift on his own resources'.[1] The force consisted of 18,000 men, of whom 10,000 were combatants; and there were 9,900 animals, of which 7,200 were for transport. Natural supply was cut to a minimum, it being hoped that local supplies might be available on the road. The column carried preserved meat for two days, meat on the hoof for ten, bread for five, and tea, sugar, and rum, for thirty. Transport also was on a considerably reduced scale. It was anticipated that, if local supplies failed, in the interests of mobility the latter part of the march might have to be done on half rations. Nevertheless, the distance of 303 miles was covered in twenty days, with no days of rest, and no opposition being encountered; and the march ended in the crushing defeat of the enemy and the relief of Kandahar.

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[1] Hensman: *The Afghan War, 1879–80.*

The operation presents the following salient features: the force, though large for a flying column, had its attributes, and so was mobile; further, it was launched from, and with, no fixed base behind it; and it did not march towards another sure base of supply, though its accompanying supplies were so meagre.

In the South African War of 1899–1902, three definite systems of supply were employed in two distinct phases of the war: firstly, in its earlier part before annexation took place, there is the staged advance of large forces, moving powerfully, slowly, and methodically, into the heart of the country; and secondly, the guerrilla operations which commenced after annexation, but before control of the country had taken place. Boer commanders, denied the refuge and comfort of towns of any magnitude as bases, took to a species of raid warfare. The British, secure in the possession of innumerable scattered bases, replied with the flying column. The railway still furnished the main arteries of supply, but it also became a base for the operations of the many mobile columns. The professional took time in learning to be mobile, and at first the flying column was a mere parody of its name, being composed of infantry accompanied by sluggishly moving ox-wagons carrying their supplies. Later, mounted troops became a *sine qua non* for the purpose.

The detail of a true flying column may be seen in that launched for the relief of Mafeking. The distance to be covered, over a country destitute of all supply except grazing, was 165 miles. The column was composed of approximately 1,100 colonial troops, 1,800 animals, and a few guns; and there were even 100 infantry carried in wagons. None walked. The transport carried a horse ration of four pounds only, and for the men a half meat and three-quarter biscuit ration. The march was completed in fourteen days. Small though the accompanying transport was, it was a constant source of anxiety, for it stretched along a couple of miles of road and constantly invited attack; and by the time Mafeking was in sight there was little left to issue from it. If the attack had failed, there was only surrender or a foodless retirement before the force.

In this campaign a flying column was often a gamble in speed: a species of forced march in which the weak agents of motivity, man and horse, were pressed to the utmost. It usually meant twenty miles a day, short rations, starved and ruined horses; but, at this cost, a commander won mobility.

In a preceding chapter it has been shown how in the early part of the campaign in Palestine supplies came up from the base at Kantara, in the way of the normal staged system. Later, when operations became fluid, the mounted troops employed had their accompanying transport considerably reduced; and their columns, severed from their base for self-contained periods, were launched in a changed warfare of speed and distance. These movements were—viewed from a supply angle—a combination of flying column and raid, for though these columns carried with them a reduced scale of rations, they lived on the country where they could. In the operations centring round the Third Battle of Gaza each cavalryman carried three days' rations for himself and nineteen pounds of grain for his mount; while a third day's grain was also carried in the regimental transport. This was the 'mobile ration'—officially recognized, and so termed—for operations of mobility. The very necessity for it points to a realization that, when independence of manœuvre was required and some measure of speed, then the natural supply load on, or with, the man had to be increased, even at the expense of warlike supply. Still, this ration-load, on which rested the strategic independence of the soldier and his formation, must give food for thought when the amount of rations borne by the soldier of Napoleon's mobile division is recalled to mind.

Later again, when the call for mobility became still more imperative, still further reductions in the accompanying transport were made, until the supply characteristics of the operations approximated to those of the raid itself. For the final advance on Damascus the cavalry were ordered to move as light as possible and to live on the country; and practically all their transport, except ambulances and ammunition wagons, was discarded. No staged supply system linked the divisions to their jumping-off places and maintained them; nor had they a cumbersome transport with them. A reversion to simplicity permitted the mounted man to express himself in terms of mobility. It was the mobility attained by Allenby, consequent on such measures, that afterwards elicited from Lawrence of Arabia the comment that the complete success achieved was 'a reward of the breadth and judgement which made him conceive such unorthodox movements; and break up the proper book of his administrative services to suit them; and support them by every moral and material asset, military or political, within his grasp'.[1]

We can find our principle of reduced self-containment embodied also at sea in different forms. The war galley of the ancient civilizations was not very seaworthy, and it had no compass, for these were then unknown. So it seldom ventured far out of sight of land, which was its base in an immediate and literal sense. Its cargo space was so limited that two or three days' provisions only could as a rule be carried as well as water for personnel that packed its decks and benches. Its mobility frequently depended on the muscular effort of its oarsmen, and drinking water was the same limiting factor to its strategical movement that coal or oil are to the warship to-day. Water bound down its movement to certain points on the mainland, and replenishment was necessary at short intervals by a return to some friendly shore. 'Ancient historians continually emphasize the disadvantage of a fleet operating along a hostile coast, and the advantage of having a friendly shore and strong bodies of infantry to fall back on.'[1] We see in the galley, as regards its supply characteristics, a reduced self-containment and no great powers of continued endurance, but mobility within the limits of these powers—all characteristics of the flying column on land.

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[1] T. E. Lawrence: *Revolt in the Desert.*

The Weakness of the System

The self-contained army, powerfully armed and amply supplied, can rely on itself; the raiding force is highly mobile and may disperse to live on the country, if overcome by the enemy; but the flying column has the excellencies of neither—it is a compromise between speed and power. Weakness in man-power, and the lack of a near-by base, have been the risks attaching to its operation. Paucity in numbers has been invariably necessary, if speed was desired, and in general its numbers have been counted in hundreds; occasionally, and at most, in a few thousands. It is the negation of the modern cult of numbers as spelling force.

We are back again, face to face with the logic of facts: the soldier and his domestic animal to-day can no longer support the necessary burdens of modern war, whether this be waged against a slow-moving civilized foe or an elusive barbarian. To cope on more than equal terms with the mobility of the irregular, a super-soldier and more efficient weight-carrier is necessary. The Fighting Vehicle appears as the one answer. A flying column—though the term would be superfluous—of fighting vehicles and embussed infantry shows up as a different proposition to its toiling forerunner of flesh and blood.

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[1] Shepard: *Sea Power in Ancient History.*

Chapter Six

PRINCIPLE OF LOCAL REPLENISHMENT

The Raid and Like Operations—Its Supply Principle common to other Forms of Force-movement—Examples on Land—At Sea—Difference between Land- and Sea-Raiders

The Raid and Like Operations

The raid is one of the two most primitive forms of force-movement on land, and one that from time immemorial has been the means whereby a tribal or village community has harried a neighbour, stolen his women and herds, or sought to weaken him by the destruction of his dwellings or the pillage of his crops. It has been a warlike venture particularly favoured by the nomad of the desert or steppe or by those of no very fixed abode, accustomed to great distances and possessed of horses or camels. It has been an operation of audacity and speed, in which the element of surprise is all important. In civilized warfare, it has been carried out by a limited and mobile force, composed almost invariably of mounted men, and hardship has usually gone with it.

Exercised over long distances where a maximum of mobility is necessary, its purposes have been to interfere with a line of communications; to intercept a supply convoy; to punish a refractory tribe; or to create an atmosphere of general alarm and uncertainty. It has been treated as a definite and minor operation of war.

Its Supply Principle common to Other Forms of Force-movement

Judged from the angle of supply the true raid, which has no connection with the trench raid, is but one of those forms of force-movement which are based upon the principle of local replenishment. It exemplifies fully Napoleon's dictum, that war should support war, as the raider subsists entirely on the local resources of the hostile territory traversed. In so doing he is relieved of the necessity of transporting with him any natural supply from his base. Neither is he tied to any base or supply route, for wherever he may choose he finds a new base of supplies to his hand. So his freedom of strategical manœuvre is unlimited, and his force unhampered by a mass of accompanying transport, requiring protection and by its presence trammelling his movement.

A characteristic to be noted is that, although the force is relieved of the incubus of accompanying supplies, this does not necessarily mean that the raider himself will go lightly laden. In fact, the opposite will most likely be his normal habit, for any plunder in food or forage must be carried, and a sufficiency of it, for such time as may be necessary until Fortune send the raider another haul. Food, forage, and fuel exist only in favoured localities, and the unfruitful distances between must be covered. The well-laden forager who flanked Sherman's march to the sea, the Roman legionary weighted with seventeen days' provisions, Napoleon's veteran bearing fifteen days' rations, and the swift-riding Tartar from the Gobi Desert were alike in this respect that the mobility of their formations was very largely due to the goodly load of supplies each man himself carried. The point has been ignored or obscured in the past, with the result that the raider appears as one travelling light, when the opposite has been the truth. For this reason, among others, a raid has had to be lightly equipped in warlike gear. Man and animal may bear a certain load only; and for the raid, power has had to be sacrificed to the demands of natural supply, which gives mobility.

So far we have dealt with the raider's natural supply only, the first and most important. What of his warlike supply?—arms, ammunition, equipment, clothing, boots, and the like. Normally his force is set afoot from its base with enough for the estimated period of the operation, and examples are not common where the raider has been forced to seek that of his foes, so that he may remain in being as an armed and offensive force. These, however, do exist, as we have previously shown: in the final phase of Von Lettow Vorbeck's campaign in East Africa, when he replaced his dwindling munitions from captured enemy stocks; in the later stages of the South African War, when Boer commandos would look to the capture of a convoy to replenish their armament; and in the Punic War, when Hannibal resorted to the same expedient at the Romans' cost. In medieval times, the privilege of knighthood to take and hold the weapons and armour of a foe vanquished in battle, though a canon of chivalry, undoubtedly had its origin in the soldier's necessities in war.

Although the raid, in its restricted military sense, has seldom been made use of by civilized armies, many an operation of war, when viewed in the light of supply, is seen to be akin to it; for whether it be a large force-movement with an important task before it, or merely the raid proper, if local subsistence be the supply system used, they are alike. The dividing line between flying column and raid is not at first always easy to perceive. A force may be dispatched with a certain initial amount of accompanying supply to start off with; or this may accompany it as an emergency reserve, in case local supplies fail. But when the precaution is so taken, and the supplies with the force are intentionally made insufficient to cover the period of the operation, then obviously the latter falls within the category of raid. This must be our deciding factor in selection.

Examples in Warfare on Land

Such an operation, falling within this category, was the celebrated 'Retreat of the Ten Thousand'. In the year 400 B.C. was fought between Artaxerxes, King of Persia, and his younger brother Cyrus, the battle of Cunaxa, famous in history for having been the inception of the Retreat of the Ten Thousand. The defeat of their late leader, Cyrus, had compelled this body of Greek mercenaries, commanded by Xenophon, to find and fight their way home, then distant some 4,000 miles to the northward from the scene of the battle, and across the hostile plains and mountains of Asia Minor. They marched up the valley of the Tigris to the shores of the Black Sea, eventually covering the distance in 215 days, at an average day's march of 18½ miles. By modern standards this shows up as an amazing performance, when it is realized that the force had to rely for natural supply entirely on the local resources of the hostile lands traversed; that it had no base, no line of communications; and that, in accordance with the practice of the Greek mercenary, the retreating troops were permitted to, and did, carry with them booty and even women. To guard the train of non-combatants, and the supplies borne by pack animals and carrier slaves, in the open plains a hollow square formed the order of march; while in the mountains, successive heights were picketed to allow of easier and undisturbed passage for troops and transport.

The march embodied the supply principle of local replenishment, with that of self-containment as an auxiliary.

One of the most famous campaigns was that waged in the heart of Italy, for a period of twelve years from 218 B.C., by Hannibal the Carthaginian. It was in effect a gigantic raid, and one made compulsorily so by the interception of his lines of communications with his bases in Spain and Carthage. To Italy seldom came any reinforcements, seldom any supplies. Yet, for those long years Hannibal plundered and ravaged his way up and down the fertile Roman provinces with a consummate mobility, based on captured key points. All his natural supply had to be won locally at the expense of a hostile husbandry; and for replenishment in warlike gear, as 'fair wear and tear' took its toll of his original armaments, the excellent weapons of the beaten Romans served his needs. Compared with the masses of his dogged, badly generalled enemy, his force was small; yet the skilful use he made of it, coupled with the mobility it gained by living on the country, presented him with victory after victory.[1] We have in this campaign of over two thousand years ago a large-scale canvas of the supply methods finally adopted by Vorbeck's force in Portuguese East Africa in 1918.

An operation somewhat similar in its characteristics and their underlying principles was Sherman's famous march to the sea. On the 15th of November 1864, having cut all his communications rearwards and also having thoroughly destroyed Atlanta, his base and starting-point, Sherman commenced his march with a force of about 60,000 men. They were to live on the country, a rich one, but hostile, local replenishment being the supply principle exercised in the fullest sense. With the force went droves of cattle as an initial supply, and also a wagon train containing twenty days' supply, which was considered as an emergency reserve, should local supplies fail. By the end of the march this was still practically intact, so rich had been the country, and so expert the foragers. As the force advanced, it systematically destroyed the railway for a distance of more than 360 miles up to the outskirts of Savannah, its objective, where it arrived on December 10th. The town fell into its hands on the 21st.

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[1] Morris in his *Hannibal* gives 38,000 to 45,000 as the Carthaginian strength. Another estimate is 50,000. Rome could raise several times this number.

In the foregoing operation, there is the (to-day) amazing spectacle of a large force, composed almost entirely of infantry, actually destroying its base, and also what for its numbers to-day would be its staged and following supply route; it is supplied by local replenishment over a distance of three to four hundred miles, and for twenty-five days; and lastly, it is mobile.

We will now view one or two examples of warfare, where an even higher raid-mobility has been attained through the use of mounted troops. In the latter part of the South African War the Boer, to attain an essential mobility in the face of the British coralling system of drives and blockhouses, was driven to an exercise of the principle of local replenishment by raid tactics. At first their ablest exponent, De Wet, had the greatest difficulty in persuading his commandos to part with their prized ox-wagons and their slow-moving span of oxen; and it was not till this was done and supplies were carried on the horse and man that the commando really became mobile. As the British gradually closed in, the Boer's natural supply became more and more of a problem: he gleaned his subsistence as and where he could; the forgotten farm gave him what it might; meat when taken was killed, and each man cooked his own; and the commando baked its own bread. His warlike supply presented greater difficulties, for all the coasts were watched, and all towns held by his enemy. No bases of supply remained to him. Wastage and deficiencies had to be made good by the capture of arms and ammunition, and by *uitschudoen*—the stripping of prisoners of their clothing. Yet, such necessity made for a high measure of mobility.

In recent times we find, *mirabile dictu*, a campaign of raid-operations which in their mobility are startling amidst all the prevailing lack of it in the World War. They took place in the deserts to the east of the Jordan and the Hedjaz Railway, and there Lawrence with this mobility was enabled to effect surprise from great distances, to wreck railways and trains, to capture convoys and posts, and so immobilize almost a Turkish army corps. Loosely organized Arab irregulars protected from interference the lengthening line of British communications, as the latter extended northwards, and through their power of extended movement harried the enemy's flank and communications, so engendering an atmosphere of general insecurity in the enemy ranks.

The *ghazi* or raid is the only industry the desert knows, and here it was used with telling effect against a slow-moving modern army, endowed with all civilization's encumbrances. But how far did the supply system contribute towards this elusive mobility? Lawrence could for his Arabs have ensured ample supplies and a stereotyped European supply system, but he refused. He would have lost mobility. Early, he had realized that the value of the Arab lay in his natural modes of life, movement, and warfare. His frugality and his ability to stand hardship, together with the endurance of his camel, were assets of value to him who would use them. For instance, 'In the heat of summer Arabian camels would do about 250 miles comfortably between drinks, and this represented three days' vigorous marching'.[1] The desert was the moral and material base of the Arab, and a zone of security into which he fell back at need: its scanty thorn furnished his animal's fodder; its infrequent wells his water supplies; its resources met all his needs. Lawrence's camel-riders could cruise across the desert for as much as six weeks at a time; for it was a practice that all in the way of natural supply that should be carried by each rider was a half-bag of flour, containing forty-five pounds. This was calculated to last for six weeks, and with it the man baked his own unleavened bread. A pint of water was also carried. Any attempt to increase this meagre ration for a raiding foray was met by the invariable 'No margin'.

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[1] *The Army Quarterly*, October 1920, 'The Evolution of a Revolt'.

Here we have a force, where each carries the bare minimum of natural supply and the lightest of armament; where the bulk of supply is got from the desert, and anything extra from the proceeds of battle or loot. Yet on few occasions was there any accompanying transport, and never a line of communications or supply route in the strict sense.

Probably the greatest examples of raid warfare and of subsistence on local resources are afforded by the campaigns of the cavalries of Genghiz Khan, over seven hundred years ago. Seldom, if ever, has this supply principle been so fully exercised; and never afterwards, and probably never before, have large moving masses attained so great a mobility—a mobility in which a march of fifty to eighty miles was part of the day's routine. The horsemen who followed Genghiz Khan were organized for war as heavy and light cavalries. The former wore an armour of iron fastened with thongs of leather, and helmets of iron or lacquered leather; while their horses were similarly protected in a leather mail. Their weapons were the lance, sabre, bow, and small shield. The more lightly equipped troopers carried leather armour, a bow and javeline, only. Their natural supply was on a lighter scale—and then by way of an emergency ration—and consisted of smoke-cured meat and dried milk curds. In addition, each rider carried his own possessions. The Tartars used two and sometimes as many as four ponies each; and in their mobile warfare would quarter great areas, and with their food, the loot of a countryside, would load their animals as heavily as possible. They needed no transport, and did not know the meaning of a base of supplies. Mobility was the special attribute of their armies.

With these supply methods, a force of about three hundred thousand successfully invaded China; and with these methods a quarter of a million Tartars eight years later marched some two thousand miles, over desert wastes and through high mountain chains, to overrun Persia and terrify the West.

Examples at Sea

From the sea we may gain valuable lessons in a study of the supply methods of the pirate of the past or the sea-raider of to-day. The pirate ship, starting her voyage complete in warlike and natural supply, and replenishing later with loot of all kinds, firstly as profit and secondly as the means of continuing her further activities afloat, exemplifies the two supply principles of self-containment and local replenishment. For on the seas the haunts of men are ships, floating communities meet in the eyes of the raider for sack and plunder.

The supply methods of the modern sea-raider or commerce destroyer may well be seen in a study of the activities of the famous German raider, *Emden*. Once she had sailed from Tsingtau on the 6th of August 1914, the ports of the world were largely closed to her, and her own base had to be abandoned. She left it fully laden and self-sufficing; but during her long voyage of over 30,000 nautical miles, in which she consumed over 6,000 tons of coal, until her end at North Keeling Island on the 9th November, she lived largely—as a raider on land does—off the resources of the medium she traversed. The captured merchant ships of her enemies furnished her with provisions and coal, and it was always for the latter that she scanned the horizon. Coal for her engines and food for her men were her necessary agents of motivity, and on their availability depended her continued power of manœuvre. Occasionally to increase her measure of self-containment, and hence her endurance, colliers were captured and made to accompany her for periods at a time. On occasion too *Emden*, to gain mobility and freedom of action, would divest herself of these encumbering companions, so reducing her accompanying supply, as for instance when she entered the harbour of Penang to sink the Russian warship, *Jemtschug*.

Difference between the Land- and Sea-Raiders

Mobility in its highest expression has always in the past been attained by the embodiment of the principle of local replenishment, whether exercised wholly or partially. This truth may be attested in many a campaign. On land the raider on account of the weakness inherent in man and animal as carriers, has had to go lightly munitioned, so that his powers of march and manœuvre in formation are not impaired; but on the sea the warship-raider, which does not rely for movement on muscular effort, has not these disabilities. In it, mobility and power are united.

Chapter Seven

AN OUTLINE OF DEVELOPMENT

Contact between Soldier and his Supply Services—Natural and Warlike Supply compared—In the Great War—Some Principles

The Contact between the Soldier and his Supply Services in the Past

The functions of Supply, both warlike and natural, have in the past at different times moved in the field of operations, relatively to those same operations: in one era of history, the centre of activity will be forward in the battle zone; while in another, behind the army in the rear.

Of Tudor times it may be said that War's armament was launched from the Tower of London: from here the King released his stored power; from here and from other castles in the land the Indentured Levies drew their bills, bows, and arrows; and from here was equipped the siege train, its engines, and wagons. Master craftsmen, clad in the garb of their trades and skilled in the lore of siege and sap, bombard and culverin, worked and fought amidst uniformed bodies. They were the ancestors of the Gunner, Sapper, and Ordnance of to-day. The servants of warlike supply were then in the battle zone, and replenishment of their stores came from the homeland. The whole function of natural supply centred round, and fringed, the army in the field. Should the latter move, its foragers spread out on front and flank to strip the countryside; should it camp or be quartered for any length of time, then a gradually increasing area around it was denuded of supplies. But in general the supplies, so furnished, were ample in those days for the size of the forces engaged, and none came from the home base.

Later, from the time of the Commonwealth, when the Army had its first taste of tropical campaigning in the West Indies, until the Crimean War, the function of warlike supply was relegated in a theatre of operations to a base, usually a coastal one. Its depots here would be formed under the orders of the Commander-in-Chief, and would be stocked from home; but they would mainly be concerned with the collection, storage, and issue of food and forage purchased or requisitioned locally, and also the hiring of transport. Once warlike stores had left their depot, they became entirely the concern of the moving troops; while natural supply functioned wherever the combatant was. The servants of warlike supply were living a life of cloistered departmentalism, which was to last till as late as the Boer War of 1899. This was further assisted by an undesirable barrier between combatant and supply services, due to the fact that officials of the latter were civilians, whose social status was below that of the officer, by whom they were regarded with some contempt and more suspicion. It was this attitude of aloofness on the one hand and of ponderous niggardliness on the other which largely helped towards the culminating fiasco in administration in the Crimea, and the resultant public scandals of the war. It needed a woman finally, Florence Nightingale, to give the first snip to the coils of red tape with which Supply's officialdom was then bound.

The breaking away, as military corps, of the Artillery in 1715 and the Corps of Sappers and Miners in 1813, from the semi-military, semi-technical body which comprised these two services and the Ordnance also automatically assisted to delimit the boundaries of, and to cloister more closely, the function of warlike supply. Its activities were relegated to the rear, and so away from the alarms of battle. Later in the Crimea the service of natural supply, owing to the restricted theatre of operations which denied the local collection of food and fodder, became in effect a forwarding agency of supplies from overseas, so infringing a long-established principle and signalling for the first time the possibility of a fresh one.

From now onwards in the Empire's small wars, through the Zulu War of 1877, the Egyptian campaigns from 1882 onwards, and the Ashanti War in 1895, we see this same relegation of the services of warlike supply to the confines of the distant depot. Occasionally a convoy of stores would follow behind a combatant column, but this was merely in the way of an unusual addition to the customarily transported supply of the formation. In the South African War of 1899 things were better, for the functions of warlike supply moved forward in the guise of many small temporary depots and repair installations, to cope with the maintenance of the many small mobile columns engaged against a quickly moving, elusive enemy. Columns, when exhausted and depleted, would return to refit and replenish at the nearest depot to them. Supply was thus 'backward', instead of 'forward' along the ration route. The presence, however, of supply representatives was not then thought to be necessary up with the mobile columns, and so any real liaison between staff and supply officer was impossible.

In the Great War a considerable advance in co-operation and liaison was made. On the staffs of all formations from a brigade upwards there were representatives of the supply services. Supply 'backward', a relic of the South African War, quickly proved unworkable owing to the constant enemy pressure; and all warlike stores eventually went 'forward', following the ration supply route. Technical equipment too had grown enormously, and a closer supervision by skilled personnel became essential. This resulted in mobile repair organizations being pushed farther and farther forward towards the front line.

To-day, the cloistered segregation of the service for warlike supply becomes a thing of the past: those behind the scenes are being forced to join the cast before the footlights. The mechanization of war has made it so. With the growth in man-power, subsistence on local resources has become increasingly difficult, although Napoleon achieved the seemingly impossible through the genius with which he was able to disperse his armies in pursuit of their subsistence, and then concentrate them for battle. So the service for natural supply has been forced to become more and more a forwarding agency from the rear, although other factors have assisted in this evolution, such as the developments of recent years in the sealed food container, in the cold-storage plant, and in the mass-produced standardized package. So we see that to-day, in large man-power armies, the functions of natural and warlike supply are become alike. Both are now forwarding agencies to the combatant from the rear, but with activities permeating the whole body military. The growth of armed numbers has compelled the servants of the first to adopt the principle of replenishment from the rear, instead of the one-time local replenishment—so extending their activities backwards; while the mechanization of war has forced the servants of the second to extend their activities forward, right up into the battle zone itself.

Natural and Warlike Supply Compared

In our forces the large field of War's requirements in material is arbitrarily divided into 'Stores' and 'Supplies'[1]—labels derived from simpler times and originating in departmental practice. To meet the more specialized needs of a mechanized force, this field may well need a logical review and a more detailed categorization in the future. Differing urgencies in supply will demand special priorities, and possibly varying systems. Let us take the soldier's requirements, fundamentally.

He has two primary wants, food for his stomach and gear for battle. Food may be found wherever the haunts of men are, but his weapons are those peculiar to his tribe by custom and tradition. The soldier of civilization is merely its civilian uniformed, physically and mentally. As a recruit he enters the gate of his depot, having the needs of the civilian only, and doffs his garb to emerge one day with other, his warlike needs, now superimposed. When his services are made use of to invade a hostile country, its harvests, its pastures and its flocks are his to take; but for armour, clothing, and weapons he must rely on supply from the homeland. Before the growth of national armies in the nineteenth century, the principle that warlike supply must flow from the homeland, while natural supply is collected on the spot, applied generally. Clausewitz realized it in 1832, and notes it in his standard work.[1] But at that date it was not yet appreciated that the growth in armed numbers would force an increasingly large part of natural supply to be forwarded from the rear.

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[1] 'Supplies' are technically food, forage, fuel, light, petrol, lubricants, disinfectants, and medical comforts; while 'Stores' imply war material other than 'Supplies', and comprise those administered by Ordnance, Engineers, R.A.S.C., R.A.V., transportation services, and stationary stores.

On account of the heavy man-power of the armies of the ancient world natural supply was of vastly greater moment than warlike supply. These forces, Assyrian, Persian, or Mongol, to gain their sustenance spread like locusts, eating up the lands they traversed; but their armament, taken as a whole, was simple, easily borne by man and beast, and lent itself to easy tonnages from the homeland.

Froissart, and contemporary chroniclers, when painting a picture of the times of Crusader and Feudal Levy, show that provisioning was effected by foragers, or sutlers and speculators, who followed the army. The transport was that of the speculator, or else commandeered from the peasantry of the country. The forces employed were small; yet armour, engines, and warlike material generally were on the increase. They called for some form of maintenance, and early in the fifteenth century we find armament amassed and preserved in peace under royal charge in anticipation of war. When peace was made, the small forces engaged were disbanded, and with their going went also sutler and speculator. Armament naturally assumed in war an importance greater than provisions, which were War's compulsory offerings. Its importance continued to grow, and by the early part of the seventeenth century—the time when Gustavus Adolphus and his Swedes were in the forefront of the military stage—gunpowder had long been in common use, necessitating for its sieges ponderous wagons, cannon, and cumbersome trains. This was an age of small armies, many sieges, the large magazine, and often conquest by impoverishing an enemy. It was not till this same century that it at last began to be recognized that the provisioning of its soldiers was a matter for the state.

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[1] Clausewitz: *On War.*

In the brilliant interlude in warfare at the end of the eighteenth century the idea of 'the nation in arms' was born, and the genius of Napoleon was able to exploit the power of armed masses by his system of supply. From now onwards numbers spell strength, and their provisioning increasingly fills the administrative picture in the succeeding eras, where the genius of Napoleon is absent. To cope with the problem supply systems are changed, as we have shown, and the principle of replenishment from the rear is adopted and embodied for the maintenance of steadily increasing numbers. Provisioning was the main difficulty in the maintenance of the masses in the Crimea; its necessities were responsible for the supply systems in 1866, 1870, and 1914.

Natural and Warlike Supply in the Great War

During the Great War, and particularly towards its latter end, warlike material of all kinds assumed enormous proportions and increasing complexity. During its four years 70 per cent of the total orders issued by the Quartermaster-General dealt with Ordnance supply. From 1914 onwards the trend in development is increasingly towards equipment that is more and more technical and mechanical. Yet despite all this apparent growth in War's mechanical aids, operations were foremost and predominantly a business of massed man-power. Its relative requirements—we take the British forces in France for example—are revealed by a reference to the dead-weight tonnages in the principle classes of supply[1] which were shipped to France across the seas during the four years of hostilities. These were:

Hay and oats	5,439,000 tons
Food	3,241,000 ,,
Coal	3,922,000 ,,
Ammunition	5,253,000 ,,
Petrol and oil	759,000 ,,
R.E. stores	1,370,000 ,,

Judged from the angle of supply and on the above data, this was a war based on man-power and not on machine-power. Trench warfare, approaching in its routine that which obtains in the life of a large town, called for immense quantities of heavy constructional material for road and railway; its repeated attempts to blast a way to advance through the enemy's defences demanded the shells; while its myriad animals apparently ate their heads off during those long years. Out of a rough total of twenty-seven and a half million tons shipped the greatest tonnages of any one class of goods are, with the exception of ammunition, those of natural supply—oats and hay, food, and coal. From this data alone it is clear that this form of supply claimed a lion's share of transported tonnages.

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[1] Forbes in his *History of the Army Ordnance Services* gives these figures, but see also *Statistics of the Military Effort of the British Empire, 1914–20.*

In considering possible future systems of supply, certain particular features in the operations of the main theatre of war must be discounted: its warfare was static, and its legions heavily man-powered. To maintain the latter, instead of inefficient peasant carts such as had fed the constantly moving armies of the Napoleonic era, there were swiftly speeding large-capacity carriers, railway truck and lorry. Moreover, this was no war of distances: French and English bases alike were not distant from the Front; and lines of communications were short, safe, and more or less permanent.

Some Principles

From the foregoing cursory review of the relation between the soldier and his maintenance services the following principles emerge: in armies where man-power spells force, his primary needs *qua* man overshadow his others, *qua* soldier; while in low man-powered forces, natural supply fades relatively into the background, yielding place to warlike supply; and lastly, natural supply gives mobility, warlike supply armed power.

In our army each of these two main divisions in Supply have, speaking generally, been administered by one of the two great supply services.[1]

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[1] The R.A.S.C. is to-day responsible for the soldier's 'Supplies' (see note, p. 130) and also the necessary stores for the upkeep of its vehicles. With some exceptions, all other supply is the responsibility of the Ordnance.

PART II: MACHINE-POWER

'You will observe the Rules of Battle, of course?' the White Knight remarked, putting on his helmet too.

'I always do,' said the Red Knight, and they began banging away at each other with such fury that Alice got behind a tree to be out of the way of the blows.

'I wonder, now, what the Rules of Battle are,' she said to herself.

—*Through the Looking Glass*

Chapter Eight

INDUSTRIALIZATION

The Industrialization of Armies—Passing of the Craftsman—Main Features of Industrialization—The Position to-day—Growth of the Vehicle—Two Policies—Mechanization—Motorization

The Industrialization of Armies

To-day, the soldier stands on the threshold of an era of military industrialization, one akin to that which commenced in the life of the civil community more than a hundred years ago, when machinery first began to replace man in mass. Already to the man in the street the tank has come to typify armed force on land, in the same way as do the battleship and the aeroplane force afloat and in the air respectively. And like them, it is an entity of machinery. The present changes in land forces, due to substituting the motive power of petrol and steel for that of muscle and lung, have been likened to those which navies went through when steam replaced sails. But the analogy does not go deep enough. Steam brought with it more speed, more power, and other benefits like those conferred on the soldier by the I.C. engine; the seaman now had a transporting machine vastly superior to that it replaced. But the new invention did not affect the principles of his supply, and so his sea strategy, fundamentally; for his ship still relied on its power of self-containment; it still largely carried the substance of its communications in its own bottom. The adoption of the I.C. engine, however, by the soldier must inevitably change —as will be shown—the whole conception of his existing supply systems, and will force a return to the cardinal principles of other times.

Evolution in war is traditionally slow, nevertheless the industrialization of armed forces cannot fail to affect military methods, re-orient military thought, and induce something of the outlook common to industry, where labour-saving, time-economy, and efficient organization are watchwords. But let us turn for a moment to the world of civil industry, and note how labour in mass has gradually been dispensed with, to bring this about. About the beginning of the nineteenth century, labour began to flow from agriculture to industry, and by its employment and from the sum of the individual effort in the masses herded together in mine or factory an employer obtained his output. Thus, in the 'twenties and 'thirties, millers, for example, were carrying bags of grain thousands of times up and down the mill; and men, and even women, plodded animal-like in the coal-mine beneath their heavy burdens of coal. The first great revolution in industry came about through the introduction of power-driven machinery during the middle decades of the same century. The power plant began to replace man in mass, and through its agency mass-production, higher wages, and a lower labour bill have been made possible. Centralized steam-power drove machinery of every kind in every part of a works. Then, later, in response to man's unceasing quest for power, electricity stepped on to the industrial stage; and to-day its use as power spreads to almost every sphere of human activity.

With the general utilization of power, generated by steam or electricity, came also an increasing reduction in the hands necessary to obtain the same output. Power-machinery has not only reduced the necessity for numbers, but also the actual toil of those engaged; and to-day it is a universally accepted truism that 'the function of the machine is to liberate man from brute burdens'.[1] Indeed, the intimacy of man and machine has become such that, for the average city dweller, his direct contact with machines averages more than two hours a day, and during his business in town the ratio becomes considerably higher. The change in society the machine has brought about is nowhere better illustrated than in the presence in 1931 of one motor-car per 34 of the population in the United Kingdom, and one per 4·9 persons in the States.

Looking back before the era of power-driven machinery, we see a world where heavy bodily toil was accepted as the common lot. So, like enough, our soldier successors will look back in mild surprise to note that, as late as the present year of grace, the stable consumed more hours than gunnery; the gun park more than drill; harness-cleaning than horse-mastership; barrack fatigues than musketry; and the march more than the tactical exercise. A unit, to carry out the mere routine of its existence must employ so many of its men that few are left for soldiering; but by the studied use of labour-saving machines most of these man-hours, now wasted to soldiering, could be reclaimed. Immemorial custom, however, has the soldier in its grip, and he still thinks in terms of the legion and its numbers. Still, as in civil life, the quest for power, once started in the Army, will assuredly continue. It has emancipated the civilian from an age-long drudgery of manual toil; it can do no less for the soldier in that province where in the past he has had to submit to it. We say of a man: 'He's a good soldier, look how he keeps his harness'—his mettle has been gauged by his cleaning. Here we display a traditional bent of mind, which might well be subjected to the cold light of fact-finding. Should we not logically say of that soldier: 'He is a good labourer, see how he rubs and scrubs!' Work, in itself, is no virtue; though it may be a necessity. Its justification lies in the results obtained.

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[1] Stuart Chase: *Men and Machines.*

The Passing of the Craftsman

Before the coming of the power machine a man's trade set him apart from his fellows, and his individual skill further singled him out among his craft brothers. It was an age of individualistic work. The machine's arrival, however, changed the whole complexion of industry; and to-day, its economic capacity governs the extent of the worker's employment; while its universality inculcates a growing sense of mechanical operation in all sections of the community. Its adoption by society has meant to a large extent the passing of the all-round craftsman—fitter, electrician, carpenter, instrument-maker, tinsmith, or whatever he be—and his work is now being done in all the key industries by the cheaper semi-skilled operative; who may be seen at the conveyor-belt in the motor-car factory, minding the looms of a cotton mill, handling the polishing machines which finish off jewellery, or in a thousand other places. But although the machine's introduction was primarily intended to effect the transference of the skill of the craftsman to a mechanism, and so permit the employment of fewer and less-skilled hands, it has nevertheless been accompanied by a general improvement in the type of the worker, a general levelling upwards. In its beginnings it was viewed with some apprehension as man's master, and he as its slave; but now in industry a new outlook obtains: 'The progressive engineer to-day thinks of his machine not as a substitute for a man, but as an extension of a man.'[1] He would see the loom as an extension of the girl operative's capacity, the steam hammer as an amplification of the blacksmith's strength, the machine-gun as a power tool for its gunner, and the tank as a lethal machine enlarging the destructive power of its crew.

So also must be the general trend in military industrialization (or mechanization). The machine, though it be tank or trench cutter, lathe or lorry, pump or polisher, permits of no great differentiation in its servants after some decades of use and habit; they all become mechanics of sorts. The machine, in its use and method, has regimented industry; to-day, it industrializes armies. Must not mechanization tend to obliterate gradually the present characteristics of the soldier-craftsman and blur his outlines, whether he be foot soldier, artillerist, or corpsman of supply? Yet mechanize him, and he seems to grow in all directions: his mental processes become attuned to the pace the machine moves at; his perception of speed and distance is enlarged; power is seen in new terms; labour-saving is sought for; and time has more value. Instead of the peasant-soldier of the past flogging along at his little three miles an hour, his successor in a new-found mobility straddles a province, eliminating space and distance. Even now, it seems a far cry from the sturdy, but limited, individualism of Kipling's Private Ortheris to the driver-mechanic of the Tank Corps to-day.

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[1] Beard: *Towards Civilization.*

In industry, the machine saves labour, time, and money; in the military field its possibilities, as yet little explored, seem limitless. In civil life, its ultimate good has been to ensure more leisure; its adoption in armed forces must tend to reduce the length of warlike operations. During the last half-century, the hours worked in industry per week have been steadily dropping, and the working day has been growing shorter. The machine's efficiency has made this possible, and there appears no likelihood that this trend will not be maintained. As to its possibilities in war, the Italian successes in Abyssinia reveal them, and were largely based on them. There the enemy had few, or no, machines by comparison with the invaders; and for the latter, water was distilled by machinery in a land where little water was; machines in the air quickly reconnoitred and mapped a country which was little known and of which hardly any maps existed; lethal power tools destroyed an enemy having few of them; and above all, machines carried men and supplies swiftly over great distances through an almost roadless land. By the wise and labour-saving use of machines, wherever possible, a formidable native force was conquered, and still more, great distances—the bugbear of colonial warfare—were covered and supply effected. These operations clearly showed that through the machine the way to liberty of strategical movement lies open for the heavily equipped civilized force.

The Main Features of Industrialization

In industry to-day three main features may be observed: firstly, the machine increasingly supplants the muscular effort of labour in mass; secondly, by its substitution, it economizes in the number of hands necessary for the task to be done, and lightens their toil; and lastly, as each model is in turn superseded by a later one, its attendant personnel decrease in number, not merely relatively to the output obtained, but absolutely. As an example, statistics built up by the U.S.A. Chamber of Commerce show that, owing to the increased efficiency of machinery, the number of productive workers in the States dropped between 1919 and 1925 by approximately 1,700,000, and again in a similar period to 1929 by 2,000,000.

Mechanization is now a policy accepted by the great powers, and its growth will be limited only by the wealth of a country and the measure of its industrial resources. Machines will multiply, and model will follow model. Is there any reason to suppose that the eventual effects of military industrialization will prove to be different to, or its tendencies other than, those in industry which we have outlined above? Already, to some extent, they may be seen. The history of the successive missile weapons, bow, musket, rifle, automatic, and gas, is a record of labour-saving. It is only necessary to attend a morning's rapid firing on the ranges to note the economy of labour effected and the lesser fatigue produced by the machine-gun, when compared with the rifle; or to watch the man-hours devoted to the lorry per ton-mile of work, as compared with those which would have to be spent to obtain the same results with the horsed vehicle. Each new model of machine in the Service is only justified if it can do the work of its predecessor, either more quickly and efficiently with the same attendants, or else do its predecessor's job equally well with less. This is the elementary gauge by which in industry are tested the advantages claimed for any new plant.

If these assumptions, based on the experience of industry, are correct, then the soldier is faced with the problem of how the two services of his natural and warlike supply will be affected. Must not the former tend to diminish in size and importance, and the latter to increase? For it appears that, as the military machine grows in number and efficiency, military man-power must go down.

The Position To-day

Viewed widely from an industrial angle, there is in the factory of war—chaos. There, the output, or the potential output, is organized destruction, and into it the machine has been introduced, lending speed and efficiency to the business of war; whether as speeded-up power tool, in the form of machine-gun, quickfirer, automatic, and the like; or as machine-powered carrier, in the shape of tank, armoured car, train, aeroplane, or lorry. And to support and 'service' these machines, we have mass-production methods and mass repair processes. Yet alongside these there remains the older handicraft system of another age, built up of men in mass and relying for its output on weight of numbers and on the sum of their small individual effort. It is as incongruous as a Manchester cotton mill, equipped partly with great power-driven looms and partly with masses of hand-loom operatives. The soldier's lay-out is illogical, for the old and new can amalgamate as little as an infantry band with a company of light tanks in front of which it tried to march. Curiously enough, while in industry labour has been gradually squeezed out of the key occupations, such as the steel, chemistry, and dyeing trades, to its fringes, the luxury and specialist trades; in the army the combatant's trade, the primary one, has been the last part of it to be subjected to industrialization.

The Growth of the Vehicle

Although mechanization, as a distinctive term and a policy, has only of recent years come into prominence, it has long been in force to benefit the soldier, although confined almost entirely to the province of his armament. It is in improved means of movement that progress has been tardy, for the first of these, the steam engine, only came into use as late as the beginning of the last century in civil life, and was then gradually adopted for strategical purposes.

The earliest recorded employment of the mechanical vehicle in war was that of the Boydell steam tractor for pulling heavy artillery in the Crimean War. It is of passing interest to note that Napoleon, from the earliest days of his career, was obsessed with the idea of increasing mobility and, as an artillery subaltern, had discussed in an essay the possibilities of steam transport, with which scientists were then toying. But to resume. After the South African War the steam tractor was allotted a definite place in army organization. It was not till 1910, however, that the petrol-engined vehicle came to be adopted seriously, and about this time also the motor-cycle began to be extensively used for dispatch carrying. In August 1914, the War Department owned eighty M.T. lorries, but by the time of the Armistice there were in our Expeditionary Force in France and Belgium alone about 80,000. The French and Germans used M.T. for the carriage of troops on occasion in the early part of the war, although their main purpose was the carriage of supplies and stores. An example of the value of the lorry in war is shown in the following:

'During the defence of Verdun in 1916 the French used 2,500 lorries to transport an average of 13,000 men, and nearly 2,000 tons of stores, daily over a distance of 85 miles each day, and they maintained their rate of movement with little diminution for a month.'[1]

Since the Great War the growing efficiency of M.T. has been shown in many a long-distance, cross-country trial, carried out for commercial reasons or as official tests; and it has been fully demonstrated that it is possible for modern military vehicles to cross any terrain likely to be met with in the Empire, or on active service. In war, however, supply will have to content itself, in the main, with the lorry of commerce, of which the performance cannot be so high. Yet the Italian campaign in Abyssinia showed that the modern commercial lorry can go almost anywhere, and proved its usefulness over a terrain barren, rocky, mountainous, and roadless, which once would have been deemed quite outside the scope of its usefulness. Similarly, in the French operations of pacification in south-west Morocco in the spring of 1934, the M.T. vehicle—and there were many different makes and models—showed that over long desert distances it could cope with their difficulties, and yet beat the elusive native and his mount at their own game.

It was not till 1916 that the soldier saw the introduction of the tracked fighting vehicle. The Battle of the Somme witnessed its first employment in the early heavy tank, and Cambrai revealed its value and so ushered in a new epoch of war—an epoch of armour, of speed, of machines. Side by side with the further evolution of the tank, the years since the Great War have seen the introduction of the artillery tractor, semi-tracks of different kinds, and other specialist tracked vehicles. The tracked vehicle, the six-wheeled lorry, and even the modern four-wheeled vehicle of commerce, in their power of cross-country movement, go far to break the tyranny of the road, of one-dimensional movement on land; for the land surface in some measure can be regarded as the sea to the ship. And the agility and cross-country powers of the vehicle can only grow in the course of time through improved design, better material, and increasing knowledge in its handling.

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[1] Lindsell: *'A' and 'Q' or Military Administration in War.*

In industry the machine to-day reigns supreme, and armies have adopted it. Can it be doubted then that a future war will see force-movement based on the machine, on land, as well as in the air and at sea? It will be a contest of material. Lawrence and his Arabs immobilized a large portion of the Turkish forces by their never-ceasing attacks on material—the Hedjaz Railway; and the German submarine attacks in the Great War were attacks driven home ruthlessly on material—shipping. So the soldier's problems are no longer tactical or strategical only; they become largely industrial. One of these will be that—indirectly affecting him—of the output of armament factories. As the Great War drew to its close, the competition for men between the armament factory at home and the regiment in the front line became increasingly keen; more men and more guns was the unceasing demand from the fronts. In the future, owing to the increasing industrialization of armies, the demand for warlike and technical material will increase; and so the factory's claim on man-power will be all the stronger. Nor must it be forgotten that as technical equipment, such as a tank, improves and grows more complicated, the man-hours of production must of necessity grow too. Here, it would seem, is one more argument for a military policy of mechanization, rather than motorization; for an embodiment of the first, as exemplified in the tank and its crew, demands less men than that of the second, as exemplified in the bus and its load of infantry. It frees more men for the bench and forge. Here, also, seems an argument for the smaller unit and formation which, power for power, only the policy of mechanization can bring about.

Another major problem will be that of quality *versus* quantity: for example, shall we have many tanks of a lower grade or less up to date; or fewer of a high grade and of the latest design? In both of the foregoing problems it will be found that the man-hours of production are the key to solution. In fact, we may see here a fundamental principle of supply—'man-hours of production govern output'. On the care spent in preparation and planning must largely rest final success in battle; and the engineer in the factory may well supply what the genius of a great commander has done in the past—surprise. In a future war, all will centre round the machine.

Military Industrialization, its Two Policies

'The function of the machine', as we have seen, 'is to liberate man from brute burdens.' How far is this so in military industrialization? —where to-day there may be seen two clear lines of development, based on two opposing policies. These may for convenience fittingly be termed Mechanization and Motorization, and we will deal with each in turn.

Mechanization

The advocates of this policy, who may be considered as the left wing or the more progressive of the two schools of thought, take their stand on the principle everywhere prevalent in modern industry, that the machine's function is to replace the effort of men in mass; they would have it adopted wholeheartedly in armed forces. To this end, personnel should be reduced in numbers, and units in size; and instead, the armoured fighting vehicle should be increased and developed, to become the nucleus round which mechanized force would be built up. A tank brigade or a small, powerfully weaponed infantry battalion, transported on wheel, are examples of the principle implemented. By this school of thought, Napoleon's *dictum* that force is the result of mass multiplied by momentum would now be read in terms of the power of the machine and its mobility. Its views are concretely summed up in the words of one, the greatest military writer of the age: 'In future . . . military organization will revolve round two essential weapons—the Tank and the Anti-tank, and all infantry will have to be motorized.'[1] It sees in the fighting vehicle's attributes of armour, strength, and two-dimensional mobility an approach to those of the warship; and would have its strategy similarly approach, in some measure, that of the ship, and its supply systems follow those at sea. This connotes the dispersion of force over wide areas, in fact area-warfare as opposed to the linear battle-front operations of the past. Mechanized forces would no longer be tied down to linear, one-dimensional movement based on railway and road; for the railway would no longer be essential —the masses of man-power would have gone— and even the road would not be so vital.

As a necessary corollary, this would all involve a progressive reconstitution of the traditional arms, cavalry, infantry, and artillery, and their replacement by others based on the new and specialized uses of a variety of mechanized vehicles. Long-established formations would have to be broken up, and a complete re-orientation of military thought would be necessary, although not necessarily involving any departure from the principles of war, which never change.

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[1] Fuller: 'The Triumph of the Tank Idea.' See *The Fighting Forces* of July 1930.

Motorization

In the view of the more moderate school, which may be considered to advocate motorization, the machine will not, and should not, be a substitute for man in mass; nor can it replace the power of the mass. To its disciples, the tradition of a century and a half's warfare weighs more heavily than the experience of industry. To them, numbers mean power, numbers remain war's gospel—numbers in horse, foot, and guns. The machine is merely an addition, though a convenient one, for war's purposes: it is a means of clearing his path for the infantryman, protecting him, reconnoitring for him, transporting him and his burdens (or those of the horseman when necessary), and above all buttressing his arm in its traditional position as Queen of Battles. According to this school, all this can be adequately effected by the carriage at need in lorry or bus of the existing masses, and by adding to their existing formations the necessary machine-powered units, tank battalions, armoured-car companies, and the like. So the traditional arms will remain in being, and the formation suffer little change. The views of this school are epitomized in the following quotation from its literature: 'Mechanization should also be constantly extended to all existing types of horse-drawn transport, but owing to their limitations in the power of getting across country mechanized fighting vehicles can never be more than essential additions to troops which are not so restricted in their movements, and can never entirely replace them.'[1]

In the foregoing, no economy of effort is sought for, nor is any saving in life likely. Here is merely an enlargement of ideas which were growing in the soldier's mind in 1918, an enlargement of then accepted practice: tanks to smash a way for infantry in the assault, and lorries with which to submerge a position or inundate a frontier with flesh. In support of the views of this moderate school, however, there remains the incontestable fact that among European powers to-day the policy being followed is that of motorization, even though the pendulum is swinging surely, if slowly, towards a more and more extended use of the armoured fighting vehicle, and all that it embodies.

To sum up: a policy of mechanization means the substitution of the fighting vehicle for the soldier in mass; and that of motorization merely assistance. The first connotes the abolition of the horde army, the second does not. So supply systems of the future, whatever form they take, must be able to cater for both mechanized and motorized forces. Also for many a decade, during a necessary period of transition from the old to the new, they may have to maintain marching men and swift machines, components of one force.

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[1] Charrington: *Where Cavalry stands To-day.*

Chapter Nine

THE MACHINE

The Basic Unit in War—Characteristics of the M.T. Vehicle—Its Mobility—Its Capacity for Self-containment—Wrong and Right View of the Fighting Vehicle

The Basic Unit in War

Force is built up of units, and in war it has been measured in terms of ships, aircraft, or men. Warfare takes its character from the basic unit on which, and around which, its forces are built up. In the air, were air forces composed of airships, aerial warfare would assume an aspect very different from that we know, based on the aeroplane. On the sea, the characteristics of the oared galley, the sailing-ship, and the steamship are the characteristics of the warfare of their times. On land, the man has been the basic unit, now dominating its warfare as horseman and now as foot-soldier, and affecting it accordingly: his limitations, his needs, and his powers, have given it the form we know.

The soldier, viewed from the supply angle as a war unit to be maintained, has certain salient qualities: he is able to carry a burden up to a certain weight only, and is subject to fatigue; his speed is very limited, and his power of progress-cum-subsistence very small. On the other hand, he can find his food wherever he goes, can work in any climate, and traverse any ground; he is adaptable to almost any conditions, but must be maintained and provisioned whether working or not. Again, if we take him more widely, as one of the many components in war's grim machinery, he, the soldier, the man, reveals himself as a delicate sentient organism and, if modern and civilized, particularly so: he is subject to the sensations of thirst and hunger, heat and cold, fear and pain—to name but a few; he has a hundred sensibilities, all directly or indirectly calling for their material aids or remedies. His wants are innumerable, and all society's resources minister to them. Can we but reduce his numbers, then we reduce the immense material necessities essential to his efficiency and well-being—hospitals, camps, depots, stores, laundries, canteens, and the like, all in their turn demanding their quotas of attendant personnel and working material.

Let us now consider our soldier-unit from another angle—that of cost—and compare him with, say, a tank. The soldier is recruited, fed, clothed, housed, and trained till fit for his purpose; but the tank is ready the moment it leaves the gate of the factory. Should the soldier be wounded or sick, there are the liabilities of his hospital expenses and the time Nature takes to heal him; while if the tank becomes a casualty, its repair is merely a matter of the replacement of a part and perhaps some fitting. Its 'overheads' are much less, taken as a whole, than those of the man. If the soldier falls in action or dies from sickness, the state loses his productive capacity as a citizen and as a potential father; but in the case of the tank, once it has to be abandoned, the matter is finished and the account closed. 'Counting all costs, it can be stated conservatively [and shown] that each combat soldier costs the Government ultimately about the same as a light tank produced in quantity.'[1]

Modern industry, in its machines and power plants, offers the only release from the tyranny of numbers, and their necessarily colossal needs—what Clausewitz has well called 'the incubus of supply'. In the tank, for example, man-power has been cut to the irreducible minimum, and its multitudinous needs are correspondingly minimized; while those of the machine—'the extension of the man'—are relatively small. They comprise spare parts, petrol, lubricants, electrolyte, armament, munitions, wireless—all in the main stores of metallic or mineral origin; and workshops for its overhaul, storehouses, and the attendant personnel. The machine can brave the elements; it needs no accommodation; it suffers no sickness; it has no emotions—it is insentient. As a war unit, complete in all its components, both animate and inanimate, if compared with its equivalent in fire power of many soldiers, its total needs are few.

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[1] See Major John K. Christmas, Ordnance Department, U.S. Army, 'Tanks and Tactics' in *Army Ordnance*, January–February 1937.

The Characteristics of the M.T. Vehicle

The soldier's successor, the I.C.-engined vehicle, which becomes a new basic unit in land warfare, has been adopted in various models and makes; but, speaking generally, these fall into one of two classes:

(*a*) specialist fighting vehicles, which may be armoured like the tank, or unarmoured like the wireless lorry; and

(*b*) normal commercial load-carriers, adopted or adapted for military purposes, such as the ordinary lorry or motor-car.

Materially, the fighting vehicle differs but in degree from its humbler relation in the transport: it may be armoured, and so impervious to small-arm bullets; be tracked or run on six wheels, and so travel better across country; or be fitted with special equipment, and so fulfil some particular function. But its main qualities, those with which it is endowed by the I.C. engine, remain the same. Now any supply system for its maintenance must be planned in accordance with the likely character of its operations in the field; and these in their turn can only in the first place be based on, and governed by, the vehicle's own peculiar qualities. What are these? The vehicle was originally designed to go quickly, and to carry a load; and from these, its primary purposes, follow logically its two outstanding qualities—its mobility, and its capacity for self-containment. Above all things, it is a load-carrier, and a powerful one; but it is the very obviousness of this quality which has caused it to be so often ignored or overlooked in the past, when the problems of its maintenance have been in question. Let us consider these two main qualities in some little detail.

The Vehicle's Mobility

Mobility, in itself, comprises the qualities of speed, agility, and endurance.

The fighting vehicle has to-day a speed to which the nearest approach in the past has been that of Genghiz Khan's nomad cavalries or Lawrence's Arab raiders, and each successive model handed out to the soldier is certain to be—as has been the way with the motor-car—a little faster and more efficient. Its servants, once rid of the traditional trammel of three miles an hour as a marching pace, think in hours of travel, as the motorist does. Before the Great War, sixty miles represented a three, or even four, days' march for a division; to-day, it means a few hours, or at most a day, for a vehicle formation. On the fuel carried within the unit alone, the circuits of action of the lorry, armoured car, light tank, and medium tank, are in the region of 100, 150, 150, and 50 miles severally.

In the 'classic' campaigns in Palestine in the Great War fifteen miles proved a long march for infantry, and twenty-five for cavalry. After the breaking of the Gaza-Beersheba line in the Third Battle of Gaza the bulk of the British cavalry marched 170 miles in sixteen days. Conspicuous marching feats were those of the 5th Cavalry Division, which covered about 600 miles in thirty-eight days, and of a battalion of the Imperial Camel Corps, which in a demonstration from its base at Akaba covered 920 miles in forty-one days.

Turning now to some samples of mechanized force-movement, though carried out in the favourable times of peace and on a necessarily much smaller scale, what do we find? Some few years ago, five Medium tanks travelled 130 miles across an Egyptian desert in thirty hours, returning in a sandstorm too bad for other forms of transport. In 1934, spectators in the streets of Edinburgh witnessed the arrival of some seventeen light tanks and Carden-Lloyds, which had moved up from Yorkshire, covering about 200 miles easily in two days; and to all appearance both crews and vehicles completed their trip a hundred per cent fit. In the American Second Army Manœuvres of 1936, a force comprising a cavalry regiment and two artillery battalions (mechanized), and an infantry regiment and two administrative units (motorized), covered 1,500 miles in variable weather over all sorts of terrain in eighteen days, engaging in twelve major operations in that time.[1] To multiply examples, however, is fruitless; such distances and such speeds become a commonplace.

In war, speed, particularly when unexpected, confers the benefits of surprise on him who can employ it. Napoleon, by his unexpected and supposedly impossible speeds, upset the plans of his opponents time after time. As Colin[2] says of him: 'It was in a word the systematic surprise obtained by an extension of front, or by a night march, and rendered terrifying by the cannon which would be heard in rear in the mist of a morning.' Old civilizations of the East, with slow-moving armies for their guard, fell one after another before the disciplined mobility of Genghiz Khan's Tartar horsemen. This 'Scourge of God', as they were called by the Churches of the West, would appear without warning from unknown horizons, quartering great areas, pillaging, burning, and slaying, and then would disappear as swiftly as it had come. The hardiness of the Arab and the mobility of his mount in Lawrence's hands assured him a weapon of surprise which he used with telling effect against the Turks again and again, over the immense stretch of country from Akaba in the south to Damascus in the north. But surprise like this was surprise won by the genius of a great commander. In the future, factory production may, in place of genius, confer the gift of strategical surprise on a commander by the release of models with capabilities unknown to the enemy. Aeroplane experience in the Great War may well be repeated in the case of the mechanized vehicle, and the prizes of mobility go now to one and now to the other of the opposing commanders. Then, on several occasions the Germans were flying aeroplanes which were technically superior to those of the Western powers and, even though possibly less in numbers, they gained a temporary superiority in the air. During those years the Allies had it all their own way, so far as the tank went; they had little to fear that the enemy might suddenly produce in the field a tank more powerful and faster than their own. In a future conflict between nations, equally matched in their industrial resources, there will undoubtedly be keen competition in design, to gain superiority in battle. Here for the supply officer will be yet further difficulties; for time and space calculations, instead of being based on the standard performance of man and beast, which within small limits has not changed, will depend on the skill of the engineer and the output of the factory.

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[1] See *The Cavalry Journal* (U.S.A.), November–December 1936.

[2] Colin: *Les Transformations de la guerre.*

Agility, for so we may conveniently term the vehicle's ability to traverse obstacles, is a quality dependent on its design in engine, gear-ratios, hull or chassis, and track or wheel-suspension. It might be possible to design the machine so as to give it a special or added agility to meet the difficulties of a terrain, such as the desert sands of the Sudan, the stoney wastes of the North-West Frontier, or the soft and muddy going of agricultural land at home. But this is scarcely practicable, for specialization in design militates against ease in maintenance; while standardization facilitates the latter. The necessities of maintenance constitute the brake on specialized design.

The terrain of a theatre of war must inevitably be of two kinds: that where the fighting vehicle can operate, and that where it cannot. The first would be represented by plains, valleys, and those lands in general which support settled populations and so lend themselves to the movement of the tracked and wheeled vehicle. Even on the mountainous North-West Frontier of India the tank has proved its value, when used in those valleys where villages are, and where there is cultivation. After all, the strength and wealth of a people lie where its main communities are, and these invariably inhabit the richest and best lands. The desert, the prairie, steppe, and veldt, would also come within the first of our classes; while mountainous, forested, waterlogged, or very much enclosed country, would come within the second. These two classes of terrain must govern the vehicle's movement on land in the same way as the confines of land and water limit the movement of the ship. Again, certain areas may be passable to certain makes of vehicle and not to others: the tank will go where the six-wheeler cannot; and the latter where the ground is impossible for the commercial four-wheeler. Ground reconnaissance for the movement of the vehicle becomes as important as reconnaissance of the enemy's movements and dispositions. Even the road itself, its boundaries, and its turning circuits, become all important to the vehicle's movement in mass. Two forms of force-movement are clearly necessary: one, dependent on the power of the machine; and the other, on the muscular effort of the man.

At present, the vehicle's powers of cross-country movement are limited, but these can only increase with the years and the improvement in design and material they will bring. As an example, let us quote the success achieved by the large, low-pressure, balloon tyre to-day in negotiating the sandy wastes of the desert, which once presented so formidable an obstacle to the M.T. vehicle's progress there. Careful study of the camel's foot and its ability to move easily over heavy sand, coupled with expert manufacture, resulted in the eventual production of a tyre which was a mechanical imitation of the animals' foot. As a result, the vehicle, equipped with this tyre, can to-day beat the camel over his most-favoured ground. Another example was the invention of the axletree suspension of the driving wheels of the six-wheeler, which permits the vehicle to move smoothly and fast over inequalities in the ground, through the different wheels adjusting themselves to these, as they pass over them. The deep-treaded tyre may be quoted as another advance in design for cross-country work, for it assists the vehicle to pull out of soft or boggy ground.

This power of cross-country movement, particularly in the case of the tracked vehicle, gives it in some measure the two-dimensional movement that ships have; for it is not necessarily tied to linear movement on road and track. The land surface becomes to some extent what the sea is to the ship; and its forests, mountains, and swamps, the equivalents of island, shoal, and sandbank. At the water's edge the warship comes to a halt and, to extend its activities, can only bombard, or more effectively land marines, or disembark an expeditionary force. Similarly, forward movement across forest, mountain, or morass, will demand the action of following or accompanying infantry. The vehicle's lack of the agility possessed by man, and in a lesser degree by his domestic animal, makes it above all things sensitive to ground, and ground becomes an obsession to its commander.

The vehicle's endurance comes from steel and petrol—it is tireless. Yet in some ways it is more difficult to sustain its tireless mobility than it is to keep going its predecessors, man and animal. Unlike them, it cannot live on the country it traverses; local replenishment, as a principle of supply, is alien to it. It must have its petrol, lubricants, and spare parts, if it is to continue moving; and none of these in the normal way would be available; for it is inconceivable that anything so valuable, and so easily dissipated or destroyed, as petrol would not be removed or destroyed at the outset of hostilities by an enemy if near his frontiers. It is possible of course that the speed of invasion or raid might be so great that stocks might not have been destroyed, owing to an owner's natural disinclination to do away with his wealth without official orders; but this would seem an unlikely contingency. So we may take it that the machine's endurance will depend on what can accompany or follow it.

The machine lacks the valuable attribute, common to man and animal, of adaptability. Should their rations or forage run short, they can live and work on reduced allowances; should these fail entirely, they will still make do somehow for a time. But once the machine's lubricant is exhausted, its engine seizes up or its frictional parts run hot; there is immediate ruin and disaster. When the last drop of its fuel is used up, it becomes a dead mass of metal and its warlike activities cease. Should the soldier's clothing be in tatters or his horse's harness in bits, their wearers will still march and fight; but for the machine a blown valve, a punctured tyre, or a snapped make-and-break spring, may spell catastrophe. It must have its absolutely correct replacement, correct to the thousandth of an inch, and it must be forthcoming immediately, if movement is to continue. Moreover, such supply, originating in the factory where the particular machine was made, must go back eventually to the same source for replenishment. It follows that supply services, administering its formations, will be allowed no days of grace if failure in supply occurs, and hence supply systems must be more nearly infallible than in the past. Suspensions of activity, due to the exhaustion of marching troops, which permitted supply to catch up with its consignees, will not be so common. The machine does not tire, and its crew are less liable to the extreme exhaustion of the marching soldier; and as design improves, so will the working conditions of the crew be bettered. The exhaustion of a force will come to mean not so much that of the man as of the machine's need for overhaul and replacements. Pursuit, retirement, or some similar contingency, will wait not as formerly on the physical condition of the troops but on the maintained endurance of their machines, which will mean rush jobs of maintenance and repair. The onus for any delay will rest more heavily than ever on the supply services, and mobility's demands will be thrown via the machine on to their shoulders. Nature and rest recuperate the man, but only supply and repair service can do the same for the machine.

In the Great War the great bulk of mechanical transport was held and used by supply services, while their consignees were marching men. The great difference in speed that existed permitted a facility in supply which had never existed before, when the combatant was served by a maintenance system founded on animal transport, moving at his own pace; and which will not exist in the future for the mechanized or motorized division, when both combatant and his supply services will be moving at one pace—that of the machine. The 'Q' officer on Napoleon's expedition to Moscow in 1812, basing his plans on the tonnages and speed of the small inefficient country carts driven by undisciplined drivers, had a very different problem from that of his successor in the Great War, who could rely on a disciplined transport of large-capacity carriers, moving much faster than the troops ahead. In the future, the problem of catching up and ensuring daily supply to tank or armoured car, able to move seventy or a hundred miles a day, must inevitably bring back a problem common in earlier ages. Does it not seem likely that its solution will be found in supply methods which were in vogue then? The transport lorry, owing to the favourable conditions obtaining in the Great War, sealed and crowned the system of replenishment from the rear as a principle of supply. But in the machine-powered forces of the future—if their full mobility is exercised, and if they are used boldly—can the principle be practised and the system work?

The Vehicle's Capacity for Self-containment

As we have already made clear—during the last hundred years or so, in the desire to make the soldier more powerful in battle his warlike equipment has been increased and increased until he has been no longer able to carry it, and it has overflowed into his 1st Line Transport, and then into his 2nd Line Transport, and lastly into his 3rd Line Transport. In making the muzzle of the horde army, civilization's Frankenstein monster, more and more venomous, its belly has been enlarged and lengthened, till all its movement must needs be sluggish. When the Great War came, the increase in warlike gear was accelerated. The time arrived when the power of the defence, based on machine-gun, barbed wire, and trench, had become so great that the attack was invariably brought to a standstill. In order to enable the soldier to face the machine-gun bullet the soldier was given armour—a further addition to his already onerous warlike necessities; but his strength, as a load-carrier, was not great enough for this, and necessity gave birth to the tank, which eventually restored the balance between the attack and the defence. And mobility returned to the battlefield.

The tank is a powerful load-carrier, as are the many other fighting vehicles which have arrived to assist and accompany it. Instead of the one-man-power carrier they supplant, their strength is of many horse-power; and instead of being able to carry fifty to seventy pounds only, they count their load in tons. Their strength, whether as tank, armoured car, machine-gun carrier lorry, or truck, enables them to carry their crew, its equipment and rations; their armament or other special warlike gear; and their fuel and lubricants—that is, all their necessary warlike and natural supply.

In the true 'mechanized' as opposed to the 'motorized' vehicle, such as the tank, all the great power of the armament carried is wielded by a relatively small personnel of half a dozen or less. Yet its formidable power, and consequently that of its formation, allows of a wide dispersion of force, even though its numbers in men are small. This also applies, though in lesser degree, to the motorized vehicle, which in virtue of the powerfully weaponed infantry it carries constitutes a powerful unit of force; but in its case the power of dispersion can clearly not be so much, as forces built up on the basis of man-power demand more of their maintenance services in tonnages and transport, and so, power for power, are less self-sufficing than machine-powered forces. And dispersion of forces implies some measure of self-containment.

Let us now compare the natural supply carried with that of the fighting machine's predecessor. We have seen how many days' rations were carried by the Roman legionary and by the soldier of Napoleon in times when the mobility of the soldier and his formation was highest; and also how gradually fewer and fewer have been borne by the soldier of modern armies. The fighting vehicle allows many more rations to be carried for its personnel, and their small number and the efficiency of the canning industry to-day both facilitate such carriage. Why it does not do so or, if a specialist vehicle, why design has not taken the carriage of food into account in the same way as the requirements of armament, armour, engine power, and the other factors affecting it, can only be ascribed to the power of tradition. The arrival of the soldier's daily ration from the rear, together with his other needs, such as forage, petrol, lubricants, and his amenities, such as comforts, parcels, and mails, has become through the course of years so much a part, in fact the very king-pin, of the ritual of administration, that the inert weight of custom has negatived any possibility of a vehicle carrying for a period the rations of its crew. But should it prove necessary in the interests of mobility and to ensure the dispersion of forces in the field, that the tank, truck, or armoured car, must carry, say, a week's rations, then the king-pin of a long-established procedure in maintenance is knocked out and the whole falls to pieces—for re-assembly in some other more appropriate form.

Local replenishment as a principle of supply, although of little value to the vehicle itself, may be exercised by its crew; for two things lend themselves to its successful exploitation—small numbers, and dispersion—and the fighting vehicle has the first and may attain the second through its mobility. In so living on a hostile country, it will gain all the added mobility which such a method of provisioning has always assured. This would mean a reversion to the harsher and readier methods of an earlier time, when the regiment expected to have to subsist through the efforts of its foraging parties; to methods such as Sherman's expert foragers used, when they supplied his sixty thousand on their famous march through the rich Confederate states from Atlanta to the sea; or to methods used by Wellington's men in the Peninsula, when the cavalry patrol would go ahead, accompanied by a commissary, to obtain what they could from the peasantry.

The vehicle, in its ability to transport all its necessary warlike and natural supply, is a reversion, though in a new form, to the self-contained, heavily laden soldier of an earlier age, whose formation by his having a balanced load of both forms of supply and having to live on the country could manœuvre independently for considerable periods. This valuable attribute of the vehicle—its capacity for self-containment—has far-reaching implications in the military sphere. They indicate the inception of a new era of warfare, in which the anatomy of war will revert somewhat in its administrative aspects to forms it assumed in the eighteenth century, long before the foundations of administrative movement—as it is to-day—were first laid by Prussian staff officers in 1866;

to forms in which, as we have already shown, a force carried its supplies and necessities up with it and as part of it, in the guise of baggage train or rolling magazine. The latter term has an ominous sound to the soldier of to-day: he thinks of the lack of mobility the rolling magazine of the late eighteenth century engendered, but forgets the mobility it was able to ensure to the combatant under the watchful eye of a Gustavus Adolphus; he remembers the later abuse, but not the earlier use, of one of the cardinal systems of supply. (Also is it not conceivable that he does not realize that to-day the existing system of supply, based on replenishment from the rear, has resulted in a lack of manœuvre and mobility comparable to that which existed in the times of a Louvois or a Frederick the Great?)

A Wrong and a Right View of the Fighting Vehicle

Up to the present the fighting vehicle, instead of being regarded as a fighting entity, complete in all its components, both human and material, in the same way as the aeroplane or the ship, has been looked upon merely as a transporter for soldiers. This was how the war galley was first viewed by the Roman in his battles with the sea-power of Carthage. The Carthaginian, experienced in the ways of the sea, used his ship as a weapon with which to outmanœuvre his adversary, sheer off his oars, or destroy him with missiles; while the Roman, essentially a soldier and a landsman, saw in his galley merely a transporter for his invincible infantry to enable them to close with their elusive foes, and to this end furnished it with the *corvus*, a spiked bridge, which served the purpose of a grapnel. The carriage to-day of marines in a battleship would seem to be a relic of the past, when the warship's strength was gauged by its armed man-power; and when it was crammed with soldiers who would, once their ship lay alongside its enemy, board it and overcome its resistance. The traditional cult of man-power has been responsible for our present view of the fighting vehicle—it is hard to forget the ages-old picture of armed hosts marching across the lands of an enemy—and this false view of it has led to confusion in rightly viewing the problem of its maintenance and its most appropriate supply systems.

The link between the soldier and his vehicle, whether truck or tank, that increasing armament has forged, must be realized. The latter now carries for the soldier all those essentials of which he has a daily and constant need; to-day, they are many, and must inevitably increase still further, as industry throws all its resources and invention into the scales of war. Once the soldier could himself carry all his immediate and personal needs in food and armament; to-day, he cannot, and his fighting vehicle carries most of them, leaving him but a small part to be carried. But let us turn again for a moment to our military Helicon—Rome's legion. The Roman's sword and shield, as Cicero tells us, were held to be parts of his body; and the nearest stone would sharpen the first, or a handful of earth burnish the second. But the modern machine-gunner whose whole purpose and activity centres in his complicated weapon must have it carried for him—a distinct departure from the idea of the soldier who carries his own weapon. The rifle was even termed the soldier's best friend—he certainly always had it with him. Here then is the link between the mechanized soldier and his truck or tank, and so intimate a one that for practical purposes man and vehicle are one. Together they constitute a complete war unit. Once the fighting vehicle comes so to be regarded as a concrete whole, as a new super-soldier, then many a difficulty due to its present bewildering strangeness in war will disappear, and its maintenance problems will become clear. And there is practically no supply problem which modern inventive genius cannot solve.

This new basic war unit clearly lends itself to the exercise of the supply principles of self-containment, firstly and mainly; and local replenishment, secondly and as an auxiliary. Accordingly, any system of supply eventually devised for the mechanized or motorized formation must be planned to implement these principles, if the fighting vehicle is to give of its best.

Chapter Ten

MACHINE-POWERED FORCES

Mechanized and Motorized Formations — The Shape of War—Dispersion and Speed—Mobilization and the Mechanized Unit

Mechanized and Motorized Formations

To-day, the great powers are tentatively building up formations based on the power of the I.C. engine; and divisions of this kind, though still largely experimental, already exist. The trend in organization would seem in general to be along one or other of the two lines of policy which we have described as 'mechanization' and 'motorization' respectively. In one form, force is being built up round the armoured fighting vehicle as a nucleus; while in the other, the existing man-power of the former marching unit is merely raised on to wheels, with possibly the armoured fighting vehicle as a powerful auxiliary. A tank brigade, with armoured car companies or squadrons of light tanks to scout ahead of it, and mechanized batteries to support it, would be an example of the first; while a traditional infantry division, carried in lorries or buses, and reinforced by the attachment of a tank battalion, and perhaps an armoured car company, would represent the second.

It is perhaps natural that the first of these policies should carry more appeal in a highly industrialized country, such as England, where in addition a professional army, small in numbers, has always been maintained, than in others which, besides being mainly agricultural and with long vulnerable land frontiers, have long held to the principle of universal service and have relied for their national safety on their large man-power. Such must be chary of adopting a policy which is the negation of the latter, and which moreover has not yet been fully proved.

In the past, with the exception of the Great War, in which great national forces were used by England on the Continent, her mainstay in war has been her navies, supplemented by small expeditionary forces to carry war into an enemy country. Her warfare, in consequence, has largely been an affair of machines—ships propelled by the winds or by steam—handled by a personnel, relatively small when compared to that on which Continental powers have relied in their warfare on land. Thus Nelson's fleets, which unseen and unheard on their distant oceans foiled Napoleon's efforts to break England's might, coupled with her expeditionary forces in the Peninsula, made a call upon her man-power which was considerably less than that found necessary in France to maintain the great armies of the Emperor. It is to the maintenance of her fleets that England has in the main devoted her wealth and industrial resources; she has been, and still is, one of the world's greatest workshops. Warfare on the sea, and now also in the air, rides with her genius and derives from her industry. Thus in the future, a policy of wholehearted mechanization for her regular forces at home, entailing but a limited personnel, would seem more in keeping with her past national strategy and more appropriate to her resources than one of large forces, based on man-power, which could ill be spared from industry. The latter forms the base from which may be launched machine-powered forces—fleets, air squadrons, and mechanized armies. Reduce its hands, to build up such man-powered forces as were sent overseas in the Great War, and the industrial base is correspondingly weakened, to the detriment of its output. Modern war hinges on industry, and the methods and principles of the latter cannot but affect it increasingly. One of its cardinal principles is to save labour and effort, wherever possible; and mechanization in an army embodies this principle.

Let us look at the matter more concretely. The original 60,000, dispatched as an expeditionary force to France in 1914, magnificently trained and equipped though they were, represented but a slight addition to the hundreds of thousands France already had in action in the Battle of the Frontiers—the next army on their right, that of

Lanrezac's, was actually 300,000, strong! To-day, however, when the great powers can show but two or three mechanized or motorized divisions only, owing to considerations of cost or industrial limitations, three or four fully mechanized divisions thrown overseas to assist an ally would be a very different matter. That ally's strength in its swiftest hardest-hitting troops would be doubled; it would receive princely aid. For the above reasons, it would seem that a policy of mechanization must inevitably, if gradually, supersede that of motorization.

The Shape of War

What will be the picture of mechanized operations? What shape will war take? Since Cambrai, where the tank showed its mastership of the battlefield and so ushered in a new era of warfare, theory based on experiment has been crystallizing, till now at last the picture becomes clear. In a recent issue of the *R.U.S.I. Journal*[1] there appeared the summary of an article published in the *Bulletin belge des Sciences Militaires* on the German army organization, which surprisingly enough, in view of its novelty, appears to have elicited at the time little comment in print.[2] According to the writer, 'The German doctrine of war is that decisive victory will be obtainable only by a complete and overwhelming surprise. Standing armies only will be employed and there will be no time for the preliminary mobilization of masses of men.' He goes on to explain that this strategical surprise is to be attained through the formidable power—unmobilized, and the high mobility—instantly released, of the spearhead of invasion, which would consist of troops entirely machine-powered. These swiftly moving mechanized or motorized formations would be assisted and preceded by aircraft; while behind, as soon as mobilization permitted, would follow by rail and road massed man-power armies as they were in the Great War, to inundate an enemy's frontier or to guard their own. The machine-powered forces composing the spearhead of invasion were outlined as of two kinds: those in which the armoured fighting vehicle predominated; and those in which infantry were transported on wheel.

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[1] See the *R.U.S.I. Journal*, November 1935.

[2] Its views were, however, discussed in France early in 1935, and were commented on in *The Times*.

A lecture on mechanization[1] delivered at the Royal United Service Institution in 1937 revealed the outlines of a very similar picture. Modern war was shown as an advance in three waves, of which aircraft represent the first; mobile machine-powered troops, the second; and 'line-holding troops who must advance to secure the ground which has been gained by the combined action of the air and the mobile troops', the third. The mobile troops were visualized as of two types: those to operate in open country suitable for the tank; and those able to operate in enclosed country, unsuitable for the tank's fullest activities. The first of these was to consist of tanks, assisted by other armoured or mechanized vehicles; while the second would comprise in the main motorized infantry and other transported troops, assisted by light tanks. We may see in both the above pictures of modern war two types of force-movement: that in which the power of the machine is utilized, not only to transport the man, but also to multiply his fighting capacity; and that in which he is merely borne to the scene of his fighting.

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[1] See 'Mechanization' by Colonel Le Q. Martel, in the *R.U.S.I. Journal*, May 1937.

The Italo-Abyssinian War of 1935–6 gives us, in the final advance of the invading forces, a picture not unlike that painted above. When operations eventually became mobile, during the period March to May 1936 after the great battles which broke the Abyssinian resistance, invasion flowed southwards from the Tigre country into the heart of Abyssinia in three waves: working widely and far ahead were the aircraft, reconnoitring, breaking up enemy concentrations, or attacking strategical strong points; then came several motorized columns, forging their way over the worst of tracks, but averaging fifteen to twenty miles a day; and then behind these again followed the masses of men, moving on foot slowly, constructing roads, and making good the country taken. In the same way, the final advance on Harrar through the Ogaden country from the original coastal base, Mogadisho, in Italian Somaliland, may be viewed as invasion carried out in three waves.

In the great conflicts between horde armies, which have marked an era in which armed man-power has attained its apotheosis—conflicts such as those of 1870–1 and 1914–18—what, in its broad outlines, is the picture we get? An inundation of a frontier with flesh and blood! an irruption across it of a nation's armed man-power!—the offspring of an age when the strength of nations still lay almost entirely in their agriculture and its manhood. And to-day, in this age of the machine, what is the picture forming? Its outlines we have roughed in above. Still more may be seen in a study of the recent war in Abyssinia; where, in the last phase, machine-borne forces equipped with lethal power-tools were launched on mobile conquest over long distances from a huge base of almost immobile man-power at the northern end of the invaded territory. Whether in the homeland, from which are equipped and sent machine-powered forces of ships, of planes, or of fighting vehicles; or in the port, aerodrome, or land base, whence strategy in the field draws its support; or in the infantry-held position, from which armoured operation sets out; man-power in mass constitutes the base from which the war machine is launched. The latter is increasingly civilized man's weapon to execute his mass purposes in war, as it is in peace. As early as 1863, Samuel Butler wrote[1]—but how truly, he was never to know:

> 'Day by day the machines are gaining ground upon us; day by day we are becoming more subservient to them.... The upshot is simply a question of time, . . . the time will come when the machines will hold the real supremacy over the world.'

Dispersion and Speed the Key-Notes to Mechanized Operations

It needs no great flight of imagination to enable us to visualize in some further detail the operations of a mechanized force, once the characteristics of the fighting vehicle itself are thoroughly appreciated. We should expect to see —putting on one side for the moment all questions of supply—invasion carried out swiftly by many small and powerful formations, based on more and smaller bases than have been customary in the past, and dispersed over a wide area and using many routes, but connected and controlled by wireless. In the territory invaded, there would be at first a similar dispersion of similar forces, unless the frontier was guarded by a strong belt of fortifications; and in addition there might possibly be the further complication of an outlying fringe of light volunteer car forces, perhaps somewhat like the lightly armed native auxiliaries which almost invariably in Rome's colonial wars accompanied the legion, and scouted and skirmished for it.

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[1] See O'Brien: *The Dance of the Machines.*

The distances covered in a day by mechanized or motorized forces might be anything up to a hundred miles, and the speedometers of tracked vehicles might register quite a fair portion of this as having been done across country. The road must eventually present, for strategical movement, the same picture when carrying military traffic as it does in peace, when filled with hurrying civilian cars and lorries. Any attempt by the military vehicle to imitate the close columnar movement of marching men in the past, and yet attain high-speed averages, is doomed to failure; it can lead only—no matter how strictly controlled—to low speeds, congestion and an incitement to the hostile aeroplane to come and bomb it. Columns on the road, whether moving or halted, reveal their presence clearly to the air patrol, besides slow movement tires the driver and is bad for the engine and wasteful of petrol. Military traffic will have to copy civilian in its loosely oscillating, individually controlled, fast movement. Dispersion on the road, as well as over an area, must be the principle eventually adopted. Failing all other causes, the hostile aeroplane will make it so; it will force a policy of dispersion on ground forces. For to avoid its attentions, wherever possible, concealment will have to be sought and concentration avoided.

Dispersion of force must also lead to area fighting, where fronts and flanks may be anywhere, as opposed to the customary linear battlefront operations of slow-moving man-power armies and with a tempo slower when operations take place in enclosed country than when forces are advancing in open country.

From the foregoing it is clear that the salient features of mechanized operations will be the dispersion of forces and their speed. Dispersion implies decentralization, and this—from a supply angle—connotes some measure of self-containment in both unit and formation.

Mobilization and the Mechanized Unit

If we grant the vehicle's main qualities to be those of speed and the capacity for self-containment, these should be exploited wherever advantage may accrue. In a past where power in armies—as in industry, before the machine came into its own—was gauged in man-power, mobilization was the means adopted to increase a nation's military strength at the outbreak of war. Mobilization—'the process by which an armed force passes from a peace to a war footing'—rendered the unit, formation, or army movable and able to fulfil its particular function in war. But to-day, is it congruous to a mechanized force? Are its measures conducive to the desired end—the earliest possible contact with the enemy in the place of its choosing? Must its process, as commonly understood, not detract from the mobility inherent in the machine and waiting but an instant's release?

It remains: an example of military evolution; a process gradually perfected to meet a national desire for armies as powerful as possible on an outbreak of war, with at the same time the smallest call on the public exchequer in peace. Let us briefly note its origin; for it is essentially a function of supply, and deserves our attention here. Its genesis lies in the harsh terms dealt out to Prussia after her crushing defeat at Jena in 1806 by the French, and her surrender which followed. Among those terms was an enactment whereby Prussia was not to maintain a standing army of more than 42,000 effectives. This clause, however, was evaded in the Krümper system, by which men were passed through to the Reserve as quickly as possible. Austria adopted the same system in 1809, and the remainder of the Germanic states also followed suit. Then, in the Wars of the Liberation, this principle of universal service and an army reserve was brought into play. The results were striking: Prussia now took the field with an army twice as strong as that of 1806; and the Allies, with like increases attained through like measures, were eventually enabled to overthrow Napoleon. Although later in other European states long-service professional armies still held their own, here, in Prussia particularly, the principle was upheld. And in the implementation of such a policy, involving an automatic expansion of the unit, both in men and material, lay what to-day we know as Mobilization.

In Prussia's later wars mobilization, as a study preparatory to war, was increasingly perfected, and as a process was speeded up. Other nations had also adopted the principle, until mobilization became not only a race against time and a competition in efficiency, but also a means whereby the valued element of surprise might accrue to the commander whose forces were enabled to concentrate with the greatest secrecy, efficiency, and speed. Such benefits were revealed in the admirable supply system brought to light by the Prussians in 1866; in the clockwork precision of their advance into France in 1870; and in the unforeseen increases in the Teutonic masses of invasion through Belgium in 1914.

We find Lord French, the commander of the British Expeditionary Force in 1914, writing in his book, '*1914*': 'From the first it became quite evident that the German system of mobilization was quicker than the French. There was reason to believe that Germany had partly mobilized some classes of her reserves before formal mobilization.' Actually, 'The French thought they would have to deal with 60 Divisions, whereas they were opposed by 78 Divisions plus 14 Landwehr Brigades and 2 more Cavalry Divisions than they had reckoned with.'[1] Indeed, so integral a part of the organization of modern man-power armies has mobilization become that the order for it to begin is the practical equivalent to an opening of hostilities; for once the gigantic machine of a national mobilization is set in motion, it is difficult, if not dangerous, to arrest it.

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[1] Spears: *Liaison 1914*.

Still, no matter how its process is speeded up, how efficient its preparation, precious days must inevitably be lost before a force can move to seek its foe. Conceive the meticulous cumbersomeness and the far-reaching effects consequent on the general order 'Mobilize': the masses of reservists hastily converging on the many centres of mobilization; the detailed arrangements for their accommodation, and its furnishing; the sudden conversion of these civilian masses into soldiers; their equipping and feeding; and the hurried drawing of vehicles and stores by the unit. Let us take an example. Great Britain declared war on the 4th of August 1914; embarkation of the B.E.F. commenced on the 9th; and the whole force was concentrated in the Cateau-Maubeuge area by the 21st, contact being gained with the enemy the next day. And yet, as is well known, the British mobilization was carried out with the utmost smoothness and dispatch. The French had estimated that the German cavalry divisions would be mobilized in two days; the covering troops in six; and that concentration would commence about the fifth day and be completed on the fifteenth. These were the minimum times deemed necessary, even in a mobilization speeded up to such a surprising pitch of perfection as was Germany's. Mobilization means that a regiment, at the least favourable moment of its life, when it should be most ready and standing by, must perforce submit to this sudden internal upheaval; it is like a runner, waiting for a race, being suddenly afflicted with colic. In the past, the success of mobilization has largely hinged on the smooth running and efficient performance of the railway. But, in the future, can its freedom from interruption be assumed? Will not one of the first and pressing duties of an air force be that of impeding and embarrassing the mobilization of its enemy's armies?

For a century or so, mobilization has been held as a faith and established as a military study; it has been the curtain-raiser to the war of masses. In its present military sense, the term itself appears to have been first used about 1799.[1] On the other hand, mechanized forces—those where all moves on track or wheel—are a very recent conception; and mobility is their special attribute and their *raison d'être.* Both terms derive from the same source, though in their dictionary sense the latter implies 'the freedom to move', and the former 'the rendering movable'.

The main problems which mechanization presents for solution all centre round this new-found mobility; and on account of this quality mechanized forces will undoubtedly constitute the

[1] See the *Shorter Oxford English Dictionary.*

spearheads of invasion. But their value will then depend, not only on their speed of travel, but also on how quickly their formidable power is unleashed to its task. In a muscular past, the horsed fire brigade was mobilized to a high pitch of perfection; but compare it with the modern motor fire engine—and how much quicker the latter! The crew leap to their seats; big power-driven doors slide open; a starter button is pressed . . . and it is away. An outbreak of war is not unlike a fire. The mechanized unit has, besides its great mobility, an offensive power far exceeding that of its prototype of 1914, and all this mobility, all this fire power, can be exercised by a personnel relatively small in numbers. Where then for a unit the value in numbers? Or in an addition to its material? Might we not, instead, see a unit smaller in size, but always maintained at an effective war establishment; one ready to march at an hour's notice on the word 'Go', instead of one obliged to wait on the order 'Mobilize', with all its attendant delays and complications? The reservist himself presents no difficulty, for he can equally well return to the Colours to build up a reserve formation, as to inflate an existing one.

Let us assume, however, that mobilization as a necessary preliminary to mechanized warfare remains. If so, then the speed inherent in the vehicle will call for a further and a further speeding up of mobilization, so that the unit may exercise its great speed at the earliest possible moment. This being so, a shorter and yet shorter time will be available for the unit to absorb its reservists; and it will be in any case almost immediately engaged, and certainly so when only a land frontier separates two hostile countries. Experience in the Great War showed on many occasions that, when the time requisite to absorb the reservist properly was not available, the cadre suffered; for the man called up must have time to settle down in his new surroundings and get some little training. Over-reinforcement, even in a man-powered formation, of a unit due to move into battle early is actually detrimental to it, the unit being worse off than it was when at low strength. This was particularly revealed in September 1914 just before the Battle of the Marne, when reservists from the depots poured into French units which had suffered heavily in their retreat after the Battle of the Frontiers. Thus, added man-power does not necessarily always mean added strength.

The mechanized vehicle gives effect to its inherent mobility in three ways: firstly, through its capacity for instant action; secondly, through its speed of travel; and thirdly, through its capacity for self-containment. Its unit, with its vehicles once equipped with their full crews, their war armament and munitions, their petrol, lubricants, spare parts, and rations, for a pre-determined to-be-self-contained period, may move at once from its peace station. It waits for no reservists; it requires no extra transport; it need submit to no railway timings; and, once on the move, need wait on no nightly ration to arrive. It has been made free to start instantly and to move independently. Let us turn to other forms of mechanized force-movement. Would the warship, carrying out its peace-time routine on the high seas, immobilize itself on a declaration of hostilities by putting into port, so that its personnel and stores might be added to and its strength so increased before voyaging abroad to seek its foes? Or would the first-line aeroplane squadron similarly stultify its great mobility by delaying its urgent mission on an outbreak of war for considerations of extra men or stores? Part of their virtue lies in their capacity for instant action; and the mechanized land force is akin to them in its inherent mobility and capacity for self-containment.

Another aspect of the matter is that of depreciation. The man, leaving the Colours, depreciates very little physically over the next ten years, say from twenty-five years of age to thirty-five; his value, when called up as a reservist, after a little training is not much less than it was. The vehicle, however, depreciates quickly, and after a half-dozen years or so the sale price of a lorry or car has dwindled to a fraction of its original cost, its loss being even assessable in standardized annual percentages. Its life and value are governed by the march of industry; whereas the horse-drawn vehicle of the past offered little opportunity for any drastic improve-ments, and, providing its condition remained good, was as valuable for its purpose after twenty or thirty years as it was originally. It may be queried: 'What of other modern warlike stores, such as guns? Do not these suffer, as the mechanized vehicle does?' These are specialized stores, peculiar to battle and, although they can be outclassed by other and later types and models, in their production and improvement the field of competition and the market is relatively limited. The mechanized vehicle, placed in mobilization storage even one decade, would find itself outclassed by up-to-date models. For example, the old well-known Peerless lorry of the Great War can hardly be said to compete with the models we see to-day.

If the soldier would add numbers to numbers on an outbreak of hostilities, he must store a vast number of mobilization vehicles, and during the long years of peace these will be steadily depreciating, even though not in use. It is for similar reasons and to get the fullest value from money initially spent, that a haulage or transport firm will never, if it can be avoided, permit a vehicle to stand idle or to run empty; it must be under load, and working for every possible hour of its short life. Each succeeding generation does not necessarily produce a stronger and more efficient man; but each year definitely reveals a better vehicle. The man is physically a standardized article, mass-produced by Nature, and the ages change him little, if at all; while the machine, the product of his brain, is constantly changing. What then will be the value of our mobilization vehicle on an outbreak of war? Surprise will be the gift to the force whose machines are then most up to date.

That reserves of war vehicles must be held, to replace initial war wastage, is undeniable; and that the production in large numbers of specialist vehicles involves the labours of industry for many months cannot be gainsaid—such holdings are inevitable. But this in no way weakens the case for the smaller unit, powerfully munitioned, of the latest type, and able to move on its business at the word 'Go'; or for the saving that would accrue in not having to store masses of mobilization vehicles through the long years of peace—depreciating.

So again: is mobilization really essential, or even advisable, for the mechanized unit? Armies have not always, in the field, been huge in man-power; have not always had to suffer an internal inflation on a declaration of war. And war cannot be stereotyped, or a doctrine hold for ever. Small professional armies were in existence for a long time before the birth of national armies in the Napoleonic era. They came into prominence when Louvois, War Minister to Louis XIV, introduced his new system of organization; and the period 1668–72 may be regarded as the point in history at which the standing military power, such as it existed in the eighteenth century, reached the zenith. Its regiments were maintained by the sovereign, and on his word marched out from their garrisons, complete and ready for war; and its armies were in the true sense standing armies. This was a time when armies were small; war was limited to the army itself; and mobilization, as an essential preliminary to war, was not yet thought of. Here then—for history moves in cycles—appears a precedent for a new phase of warfare which, based on the formidably offensive power of the mechanized unit, demands the earliest release of the machine's activity, if its full value is to be realized.

In view of the growth of the military machine and its increasing and inevitable replacement of man-power, one cannot but be faced with the surmise whether in some future Continental war the first, and perhaps disastrous, blows dealt will be due to a strategical surprise sprung, not by a perfected mobilization, but by its studied omission. To conclude: mobilization, as conceived to-day, for the mechanized unit can only spell immobilization.

Chapter Eleven

THE EXISTING SUPPLY SYSTEM

Inadequacy of the Existing Supply System—Its Lay-out—The Air Threat

Inadequacy of the Existing Supply System

Will the existing supply system adequately serve the fighting vehicle? Will it meet the needs of a swiftly moving and widely dispersed power-driven force?—for it has been designed to cater for its antithesis, huge masses of man-power, marching slowly and moving cumbrously. The speed of the tracked combat vehicle is steadily increasing, and its reliability too, with every new model which the soldier receives. As we have already shown, the supply system is founded on the principle of continuous replenishment from the rear, and is organized in successive stages; its effect is that a force is tied to its base by a slowly lengthening umbilical cord, a never-ceasing flow of supply.

The Italian masses in Abyssinia in 1935, who were entrenched and holding the Tigre country around Adowa, Adigrat, Adsum, and Makalle, obtained all their supplies by the main Massawa-Asmara road, the light railway running more or less parallel to it, and the limited road extensions from these; and as long as operations remained static, these limited routes with their continuously running freights sufficed. Yet, as De Bono, the constructor of this great road, confesses,[1] maintenance was only possible for a portion of the total force disembarked. He writes: 'In one month and five days we penetrated seventy-five miles into enemy territory, building the road yard by yard, and able actually to dispose of only two-thirds of the forces dispatched to the colony for these operations.' In its operation, the system connotes certain conditions and displays certain features. Its efficiency being founded primarily on the railway, with supply routes radiating by road from railhead, the system is rigid and fixed; and its elaborate and meticulous organization demands time, and its routine freedom from interruption, to ensure this efficiency. Thus in 1870 the problem of the necessary maintenance by railway of the growing masses which were investing Paris became one of such gravity that it formed the motive for the siege or investment of seventeen fortresses, not counting Paris, Sedan, and Metz, in order that additional railways or parts of railways might be opened for the carriage of supplies from the Fatherland. It is indeed open to question whether, but for the opportune fall of Metz and the consequent release of the north-eastern railway system, the siege of the capital might not have had to be raised and the investing forces withdrawn. The objective in attack after attack on the Western Front in the Great War was to capture some railway system of maintenance, or to dislocate it. Thus the German thrust towards Amiens in 1918 succeeded in interrupting the flow of traffic from the northernmost Channel ports west and south-west-wards to the hard-pressed armies of the Western powers. The successful advances of the Allies in the autumn of 1918, although they completely dislocated the vital maintenance systems of the Germans, also had the effect of denying further rapid movement forward to the victorious masses of the Allies.

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[1] De Bono: *Anno XIIII.*

The system requires protection provided, either automatically by a widely flung screen of advancing troops, such as Von Kluck's advancing masses initially furnished in 1914 in their great wheel out of Belgium, or such as failed to be provided by the British, when they were forced to retreat behind the Marne, so uncovering their supply routes to their base ports on the Channel; or else by an extensive trench system ahead, such as later stretched from the Channel to the Jura; or else by the diversion of a considerable number of effectives from the force operating—a necessity peculiarly characteristic of colonial warfare in general. There, as a rule, the forces employed are small, and the distances to be traversed long. When Lockhart in 1897 marched with a force of approximately 54,000 men including 20,000 followers, and an accompanying transport of nearly 24,000 animals into the heart of the Tirah, his line of communications from Maidan in the Tirah to his railhead at Khusalgarh was about 100 miles. And to maintain this, some 8,000 to 10,000 men and 18,000 animals were employed.[1] Even in the operations of great modern armies, despite the protection automatically afforded by the screen of their advancing masses, additional security must be given to the supply routes by the detachment of effectives from the main armies. For instance, by the time of the opening of the Battle of the Marne corps and divisions of the First, Second, and Third German armies, which carried out the great wheel which was to envelop the left flank of the French armies and roll them up against the Swiss frontier, were in most cases reduced to fifty per cent of their original numbers. The establishments of a corps and division were respectively 36,000 and 17,000; and the total mass of these three armies, as they originally started, was about 760,000. The great wastage came from two main causes: firstly, casualties due to the incident of march or battle; and secondly and mainly, effectives being diverted for duty on the long lines of communications, stretching far back through Belgium to the Fatherland. Such was the drain on the fighting power of the horde army, which its staged system of supply from the rear must necessitate.

The main bases of the system are few, have enormous supply installations, and cover large areas; and when operations are in progress, its roads become congested and its railways, choked. Lastly, as the efficiency of the whole depends on military operations ahead moving according to plan—following the Clausewitz conception—the system lacks suppleness and elasticity. Let us, however, in the abler words of others depict the modern horde army on the move:

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[1] See Shadwell: *Lockhart's Advance through Tirah.*

'Their sprawling columns stretching for tens of miles along congested roads, their acres of horse lines and the still larger areas covered by supply parks and depots at the bases and on the lines of communications, all offering splendid targets to aircraft.'[1]

And then the horde army and its supply, in battle:

'A battlefield had been selected. Around this battlefield walls were built—double, treble, quadruple of enormous cannon. Behind these railways were constructed to feed them, and mountains of shell were built up. All this was the work of months. Thus the battlefield was completely encircled by thousands of guns of all sizes, and a wide oval space prepared in their midst. Through this awful arena all the divisions of each army, battered ceaselessly by the enveloping artillery, were made to pass . . . at last the legs of men could no longer move; they wandered and floundered helplessly in the slime. Their food, their ammunition lagged behind them along the smashed and choked railways.'[2]

[1] Groves: *Behind the Smoke Screen.*

[2] Churchill: *The World Crisis.*

The Lay-out of the System

Let us review in some little detail the lay-out of supply behind the soldier in the modern division—taking our own for choice—and see how far this relic of a man-power age will stand up to warfare, so highly industrialized as it grows to-day. Its skeleton we have already outlined in an earlier chapter as consisting of a main base on coast or frontier; a railway, with regulating stations and forward feeding branch lines, ending in railheads; and from these, to continue the maintenance flow, normally three echelons of transport—1st Line, 2nd Line, and 3rd Line, as they are customarily termed.

The first is the regimental transport which forms part of the regiment, and follows it. It is divided into two portions, 'A' and 'B' echelons, of which the former bears battle essentials for the soldier, such as ammunition and water reserves, and follows him into battle; and the latter comprises his less immediate needs, such as travelling kitchens and baggage wagons, being often brigaded or bulked with that of the other regiments of the brigade in rear, when battle is imminent. Before the introduction of the M.T. vehicle in place of the horse-drawn wagon for this purpose, the number of the latter following a battalion was approximately thirty, and that of the units of other arms was in proportion.

2nd Line Transport is the mechanized transport belonging to, and forming part of, the division itself; and it works forwards and back in the designated divisional area. It embraces three administrative units, the Divisional Supply Company, Ammunition Company, and Baggage Company, comprising severally 140, 160, and 190 vehicles; and, as their names imply, the last two carry respectively ammunition reserves and bodily comforts for the soldier, such as blankets, while the first is responsible for bringing forward the formation's daily requirements in all other stores, which constitute a standardized 'lift' of 150 tons. The Supply Company moves forward and back daily between its Refilling Point and its Delivery Points, where 1st Line Transport receive the loads for the several units; the Ammunition Company moves in the same way, when its load needs replenishing; and the Baggage Company normally merely follows the formation, moving up each night to the units to hand over what they require.

At Refilling Point, which is some conveniently sited point midway on the supply route, the Supply and Ammunition Companies fill up from the Maintenance Company, which is a Corps organization and works in the Corps administrative area. This, like the two forward companies, moves daily, pendulum-fashion, between Railhead and Refilling Point, having a 'lift' of about 250 tons and comprising 200 M.T. vehicles.

Here then, in the foregoing paragraphs, is the framework of supply behind the front-line soldier and ahead of railhead;[1] and we have seen in an earlier chapter how this maintenance distance has steadily been diminishing since the middle of the nineteenth century, until to-day it is as little as from fifty to seventy miles from railhead. When maintenance distances beyond railhead grow, as the force advances, until the normal transport echelons become too heavily taxed, then an extra echelon is put into the system.

Both railway and road have a certain carrying capacity only, and this depends on various factors: in the case of the former on, among other things, the number of lines, the rolling stock, and the facilities for entraining and detraining troops; and in that of the latter, on its width, surface, bridges, and gradients. Experience on the Western Front in the Great War showed that the carrying capacity of a single line of railway, working normally, was about 6,000 to 7,000 tons per day;[2] while a double line could similarly manage 12,000 to 15,000. At the beginning of the war, the total needs of a French army corps was estimated to be in the region of 120 tons daily; but by its end, those of a division alone had amounted to 200—an example of how trench warfare invariably causes supply tonnages to rise. (By comparison with these figures, it is of interest to note that the daily tonnage required by a Prussian division in the mobile operations of 1866 was about forty.[1]) During the month of November 1916 the French railways handled up to a maximum per day of 50,000 tons for the French armies, and another 30,000 for the British, that is a total of 80,000 tons per day. Such were the tonnages necessary to meet the requirements of horde armies engaged in static warfare, and no other form of land transport, except the railway, could have coped with these colossal figures. That this was so was clearly proved in 1918, when the German lines began to give way before the assaults of the Allies. As they retreated, they left the local systems destroyed or disorganized, and recourse was had by the Allies to the services of the lorry. For this purpose all the French resources in M.T., locally manufactured or bought abroad, were gathered together, yet even this mass failed to revictual, even in bare essentials, more than half the French armies, that is fifty divisions, at a distance of more than a hundred kilometres from railheads, and this without leaving any reserve to carry forward personnel. From the above figures there can be little doubt as to the strain that is placed on road or railway by the horde army, with its huge man-power and its colossal requirements in supply—a strain that, when any hitch occurs, must spell congestion and immobilization.

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[1] Recently the Supply Company has given place to the Supply Column, which goes through in one jump to Delivery Point from Railhead; while a Petrol Company takes the place of the Baggage Company. Reinforcing the Ammunition and Petrol Companies there are now, as rearward links in the chain of supply, an Ammunition and a Petrol Park. But although all three transport echelons are now either mechanized, or fast mechanizing, and the detail of the layout has changed, the basic supply principle of continuous replenishment from the rear is, as will be seen, still implemented.

[2] See Ragueneau: *Stratégie des transports et des ravitaillements.*

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[1] See Hozier: *The Seven Weeks' War.*

And now, what of the base itself of the system? This must needs be sited at, or near, a strategic centre, which is a focus for a network of communications of all kinds. It is usually some coastal port or frontier town, permanent, well known, and the scene of much activity, and hence easily found and attacked from the air. Similarly the lines of communications, the supply routes, radiating from it, whether by road, rail, or waterway, are fixed, well known, and so offer almost equal facilities for attack. Its huge area, stuffed with man-power, and replete with camps, wharves, docks, railway junctions, marshalling yards, hospitals, depots, stores, laundries, factories, workshops, and the like, is a microcosm of the industry of the homeland—it is the heart from which the force draws its bloodstream of maintenance.

In the Great War, British main bases of this type were Havre, Rouen, and Boulogne, on the Western Front; Kantara, on the Suez Canal, feeding the forces in Palestine; Basra, on the Persian Gulf, for the force in Mesopotamia; and Salonika, for the expeditionary force in the Balkans. To arrive at some little idea of the size of a main base, serving forces built up on man-power, let us take Kantara as an example; for it was the one great base for the operation it served. It furnished the needs of the British forces which were lying about 150 miles away, before Gaza, and which at their maximum approached a quarter of a million men and a hundred thousand animals. Local replenishment, as a principle of supply, was out of the question; for there was nothing locally available, and water presented such a difficulty that it had to be furnished from a source 150 miles away in Egypt. All had to come up from the rear. So on a desolate sandy spot on the banks of the Canal there was gradually built a military town and base, which held a floating population of over a hundred thousand, wharves capable of dealing with five ocean-going ships at a time, and thirty miles of macadamized roads. From this base, across the sandy wastes of Sinai into Palestine, there was constructed a broad-gauge railway to carry stores and personnel to the distant troops, and a pipeline to convey water to them from the Sweet Water Canal.

Enough has been said of supply organization behind the modern horde army to reveal the meticulous and elaborate ponderousness of the system—a system which has not only overloaded formation staffs with the minutiae of administration, demanding for its detail 'Q' officers whose numbers go to make the great bulk of the staffs employed, but also special staff controls of its own on the line of communications.

The Air Threat to the System

Will the existing system work beneath the menace of the hostile aeroplane? In the Great War, attack from the air on rearward organizations contributed on many an occasion—and increasingly so as the war continued—to the success of a far-removed land operation; air attack on the functions of supply in rear of a battlefront became more and more profitable. Air forces are to-day so much greater in range, in power, and in numbers, that offensive action can be pressed, or its threat suggested, far into a hostile territory; while for shorter distances their rapidly increasing strengths point to the possibility of sustained action, which for short periods may even partake of the nature of an air siege. In order to impede invasion or embarrass strategy, air forces will gain results more immediately profitable through attack on administrative movement at its main base and on the supply routes linking this with the field force, than on the combatant troops themselves. In particular, any serious dislocation of the normal supply organization ahead of a main base, even for a short period, may have the gravest consequences for the force administered, on account of the light maintenance stocks located, or in movement, between the base and its force. This margin is normally very small: for example, in supplies, five or six days' rations at most. The air raider will study the transport flow of his enemy with a view to its interruption at the most vital points, such as railheads, refilling points, junctions, bridges, and the like. And it should be noted that the denser the traffic on road and railway and the more they are used to their maximum capacity, the greater will be the air raider's opportunity, and the more disastrous the results, if he be successful. The effects of an air siege, powerfully sustained, on a man-power force absolutely dependent for its life on the regular and daily arrival of its supplies may better be imagined than described.

Let us turn to the base and its activities, in detail, for a moment. The aeroplane has introduced warfare in three dimensions, so neutralizing for the land force the former value of a militarily strong position. The strongest of battle positions, or the most formidable of natural obstacles, mean nothing to the aeroplane—it can jump over them; and we must now read mobility in new terms, for the aircraft contracts space. Its far-reaching ubiquity will inevitably compel a policy of distance and dispersion on land forces and their administration. Already, it may be noted how in all countries the fear of the aeroplane has resulted, where possible, in the removal from the proximity to frontiers of important military bases and commercial undertakings of national importance. Formerly, the bases for launching invasion and maintaining its progress were often sited not far from a frontier, land strategy and its requirements being the sole factor in their location; but to-day, the hostile aeroplane forces them farther afield. For the farther away they are, within reason, the less chance there is of their vital activities being interrupted by air attack. If this be policy for the main bases of supply, what may we expect of those more forward permanent supply installations, such as the fixed railhead or the advanced base?

In the past, an advanced base has been installed, either when the distance has grown too great for efficient maintenance from the main base; or when an interruption of the supply route has been considered a possibility; or when relief has been required for a growing congestion at the main base. In the Italo-Abyssinian War, difficulties due to the congestion of the port of Massawa and the unhealthy climatic conditions for European personnel forced the construction of an immense advanced base at railhead at Asmara, although the latter was only about seventy-five miles away. The static warfare on the Western Front in the Great War demanded enormous quantities of ammunition and stores; and many advanced depots were instituted, some holding as much as 30,000 tons of ammunition. Such tonnages could not well have been held at the base ports, although rail distances were short, and further the railways themselves were liable to air attack. Any employment, however, in future European warfare of a fixed advanced base would seem of a doubtful utility, if not an impossibility, unless command of the air had first been attained. The many advanced bases installed by the Italians in 1935, to distribute supplies to their widely scattered troops, were able to function in absolute security, as their enemy had no air force; and they held large stocks of several months' supplies. In the Palestine campaigns, advanced bases were instituted at the ends of the freshly constructed railway, but their value seems to have been debatable owing to the smooth and efficient service given from the main base at Kantara, which the Turkish air service did little to interrupt.

Let us assume that, as a principle of supply, the fixed railhead or the advanced base at railhead are retained. Will they be able to function at a distance as little as seventy-five miles, or even one hundred—the present maxima for normal efficient maintenance by M.T. echelons from railhead to the troops—under the aeroplane's threat? Would railhead or advanced base not have to be moved farther back, to gain freedom from interruption? And if it moves farther from the troops, daily replenishment from the rear (our present principle of supply) becomes increasingly difficult. Does this not logically compel us to review our methods, and to consider the possibility of consulting our formation itself more as a base for itself by making it more self-contained in all vital essentials? For if it is not so self-contained, and if daily replenishment from the rear should fail, as well it might, then there would be disaster.

On the efficient working of its supply organizations must rest the success of the force they serve in the field; yet for their efficiency, work must be carried out in a scheduled routine with the greatest possible freedom from interruption by the enemy. The output and work of combatant and non-combatant are entirely opposed in their nature: that of the former is organized destruction—its function is dynamic; while that of the latter is preservative, restorative, creative—its function is static. The work of the latter must be routine-like to obtain the best results; for it is concerned with detail, accuracy, and method. The fitter will not fit to the thousandth of an inch, if one eye is on the sky and the other on the nearest door to a dug-out; the clerk's return cannot be accurate, if his attention is not all devoted to it; and the correct consignment will not go forward to the unit if the storeman does not think of his job. Morale, and its maintenance among the administrative personnel of the base become more important than ever before. In the past it mattered little, for the base and its activities were far removed from the alarms of battle; while to-day, the aeroplane brings war to the gate of the depot. It exerts its power in two ways: firstly, by its concrete attack on material and personnel with bullet, bomb, and gas spray; and secondly, by its psychological attack on the nerves of the enemy through the terror it inspires. The latter, the attack on morale, is perhaps the more formidable of the two, on account of its cumulative effect on production and output. This was seen in the Great War in the diminished output in munitions which even a few raids by small numbers of aircraft over London caused. In recent years, the same threat to morale has been further and strikingly illustrated. The Italo-Abyssinian War revealed its overwhelming effects; for there the Abyssinian resistance, with no aeroplanes to support it, the fewest of anti-aircraft guns, and no defence against gas, collapsed within approximately nine months, so confounding the expert opinion of staffs all over the world. So great was the terror inspired by the aeroplane and its gas spray and so powerless the means of defence, that the native, though one of the bravest of men, succumbed to its influence, and there was little subsequent resistance anywhere in his huge country. The operations in the present Spanish civil war have further exemplified the aeroplane's effect on morale. In the Far Eastern Sino-Japanese conflict, the aeroplane bomber has even been openly vaunted as a morale-breaker, if press reports be true; and its powers in this respect are being widely exploited.

Experience in the past shows that, although at the commencement of hostilities the labour employed at a base has been almost entirely military, and so disciplined; later on, as activities have expanded and there has been an increasing call on the services of the available military personnel for duty farther afield, civilian labour has been increasingly used as a substitute. This has been white or coloured, male or female, European or Asiatic, so making the problem of morale much more difficult. If the present be any true guide to the future, we may expect to see the aeroplane exploited more and more for its psychological, rather than its material, results; and it appears logical to assume that the lesser disciplined labour, customarily engaged at a base, will offer a more remunerative field for its activities than would strictly military targets. It can employ suspense as a secondary and very potent weapon to interrupt output. Thus, after one gas attack the threat of another will keep the working shifts on the *qui vive* for their gas masks or the anti-gas chamber; a bombing attack may be advertised with the object of keeping a base in uneasy anticipation; or the bomb with delayed-action fuse, or even the dummy, may be used to bring about the same state of mind among the personnel of the objective.

That the hostile aeroplane will devote the bulk of its attention to administrative movement and its supply routes and bases there can be little doubt; and the more rigid and permanent these latter are, the easier will be its task. The military literature of the air all leads us to this conclusion. Here is a sample extract, taken from a work on the operation of air forces: 'The more an army is dependent upon fixed and limited lines of communications, the more vulnerable it becomes. Hence the need for increased mobility.'[1] A friendly air force—we assume its presence—will doubtless at the outset of hostilities endeavour to attain mastery of the air. But, even if this happen, the administrative services of its land forces can still never be certain of immunity from air attack; while, if it fail, the base might well, at a time when its continued activity was essential to the force it served, have to submit to an air siege and a consequent cessation of its activities. The base furnishes the springs of movement to a force—and particularly so, if it is mechanized—in its stocks of petrol, lubricants, spare parts, and rations, to say nothing of ammunition, and a multitude of important battle stores. If an air force can deny these to the land force, it will be starved of movement and weakened in fight; and to-day, when the movement of forces depends so much on the petrol-driven vehicle, the presence of large stocks of stores so vital to continued movement cannot fail to attract the enemy bomber.

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[1] Squadron-Leader: *Basic Principles of Air Warfare.*

Administration may expect then to receive not only the first, but also the main, onslaught of a hostile air force; and yet, as embodied to-day in its long-established and cumbrous lay-out behind the field force, it presents to the air raider the easiest, most vulnerable, and most remunerative of targets. What an objective for the air forces of to-morrow—this organization! And one—be it remembered—still with us, although deriving from a past of heavy man-power, devised for its colossal maintenance, and built up originally on the basis of animal motive power. In the Great War the system was able to function, but fortunately for administrative movement the aeroplane had not then attained to anything like the efficiency in its speed and power which another European conflagration would call forth.

There must be a clean sweep of all from, and including, the main base in its present form, forwards: all the accumulated administrative ritual of all but a century; all the fixed cumbersomeness of Regulating Stations, Railheads, and Advanced Bases; the standardized and scheduled movement of Ammunition and Petrol Parks, and of Divisional Ammunition and Petrol Companies; the stereotyped functioning of Refilling Points, Rendezvous, and Delivery Points; and the holy rites of the Corps and the Divisional administrative area. The umbilical cord of administrative movement must be broken, to give freedom of movement to war's new mechanized offspring, which can largely carry the substance of its lines of communication within itself. Prussian staff officers were able to foresee, in the years preceding the outbreak of hostilities between Austria and Prussia in 1866, the huge growth in armed man-power, and wisely devised the foundations of a staged line of communications, a *Service des Étapes*, to meet its necessities. This system, with added elaboration, we still have to-day, when everything must indicate to the soldier changes, due to the I.C. engine, more sudden and much more revolutionary than those which confronted those logical and far-seeing Prussians.

What may we deduce from all the foregoing, to help us in the future? Firstly, a much simpler supply system is necessary, much more supple and much more elastic—one based on a policy of dispersion, which in its turn connotes some measure of decentralization and self-containment; secondly, the large main base of the past must go, and be replaced by several smaller ones; thirdly, as the latter and its activities are already being removed as far as it is strategically possible from an enemy's frontiers, the advanced base, and even railhead, must also disappear off the map, or else be replaced by some mobile equivalent; and lastly, administration must reduce its man-power, and employ every device to maintain morale and output, and this particularly in the main bases.

Chapter Twelve

SUPPLY TO MECHANIZED FORCES

A System appropriate to the Mechanized Formation—The Formation—A Return to Simplicity—A Summary—Replenishment by Convoy—The Mobile Base—Its Replenishment—The Main Base—The Shackle of Supply Broken—Strategical and Tactical Movement

A System Appropriate to the Mechanized Formation

Now the mechanized formation will not find the railway a necessity, as in the past, for movement in the field; for, being composed of labour-saving machines, such as the tank, armoured car, armoured machine-gun carrier, dragon, and the like, as opposed to those like the bus and lorry, which merely transport the soldier, its man-power is relatively small, and its carrying capacity correspondingly great. Like the ship, though in lesser measure, the mechanized formation may 'carry the substance of communications largely in its own bottoms';[1] and so too, like the ship, it may attain a large measure of independence.

Not only will its lines of communications lengthen rapidly, but they may be subject to quick lateral change, for a tactical situation may change so rapidly that within twenty-four hours a new supply route would have to be put into operation. The formation's mobility calls for a system which is quick in preparation and elastic in operation: it will not be able to spare the time needed to organize elaborate systems of maintenance on the several routes of its speeding columns; there can be no umbrella-like screen of advancing troops to guard a maintenance system in its rear from interruption, for its many dispersed columns will be operating separately, though under a general wireless control; and it will be ill able to spare effectives from its limited strength of specialists to operate or control a cumbersome supply organization. The dispersion of forces will be inimical to the idea of a line of communications as a unity of control, such as obtains to-day; and the many lines of their advance will call for several bases of supply, rather than a few large ones, irrespective of the hostile aeroplane's compulsion.

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[1] Mahan: *Naval Strategy.*

The supply officer can only surmise, in view of the mobility and dispersion of the mechanized force, that its strategy will be directed on the rapier-like lines of Napoleonic practice, rather than in accordance with existing methods, based on the Clausewitz doctrine of a pre-planned methodical advance arriving directly at its ends by the employment of overwhelming force. Should this prove so, he will at least gain some inkling of the difficulties ahead of him, though his task will be harder. His necessity to-day, if the mechanized formation is to be suitably maintained, is the same as that expressed by Guibert in 1772, when he wrote,[1] 'If it is necessary to undertake a bold operation and forced marches, the army must be able to discard the precise methods of routine'. And Guibert wrote at a time, and of a system, when supply dominated a commander's will to move—a time of a military pedantry as formal, and a supply system as sluggish, as that of the horde army to-day.

It would seem that up to the present no operation other than a raid—and certainly no sustained operation—has been deemed to be within the capacity of a mechanized formation, such as a tank brigade; for the difficulties of a sustained maintenance and support by a continuous replenishment from the rear would be insuperable. Yet in all armies this type of formation is being increasingly experimented with and adopted, and must in time play a fuller and much more comprehensive role in war. So if we assume—surely it is justifiable—that the mechanized formation will carry out progressive conquest and endeavour to hold what it has won in the same way as its marching predecessors, then it is scarcely conceivable that a commander, in the midst of active operations, will ever willingly return to some base in order to refit and replenish his force. Nor will he willingly surrender ground gained or refrain from further advance against a weakened or unprepared enemy for reasons of supply, to say nothing of wasting time and material by such a return. He will insist on being maintained wherever he is; and all supply will have to go forward. It might be thought, as happened in the Boer War, when a formation is used up and requires another new outfit in its warlike stores, ammunition, clothes, etc., that it would do well to return to some forward base to be re-equipped, before setting out again on its mission. This worked in the Boer War; but in 1914 in the Great War the system broke down, as the enemy pressure was too strongly maintained to afford the British any respite. There is no reason to suppose that there will ever be the time or the opportunity for such voluntary retirement from active operations or for the leisurely methods which were adequate against a weaker foe in South Africa. Whatever the distance, and whenever the need, the mechanized formation will have to be maintained where it is.

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[1] Guibert: *Essai général de tactique.*

So keeping this in view, and holding to our supply principle of self-containment as that most, and peculiarly, appropriate to the mechanized vehicle's unit and formation—the qualities of the latter must clearly be those of the vehicle—we will consider firstly the formation itself, and then the administrative lay-out for its maintenance in rear.

The Formation

The formation should be as fully self-contained as possible for a pre-determined period away from its jumping-off place—say, for a week, or even more; but this would depend on the carrying capacity of the fighting vehicles, the number and capacity of their accompanying transport lorries, the mobility desired, and the situation at the time. The aim, however, should be to make the division self-sufficing, as was the Roman legion or the Napoleonic division; to return again to the ideals of mobility and freedom of manœuvre proclaimed by Guibert in his writings at a time when the art of war had sunk to an ebb as low as it is to-day. But let us quote again from his famous *Essai*:[1] 'What I want to avoid', he says, 'is that my supplies should command me. It is in this case my movement that is the main thing; all the other combinations are accessory and I must make them subordinate to the movement.' And he pleads for a return to the ease of independent manœuvre of the legion—and its supply methods. Alexander the Great covered vast distances in his campaigns, and his only possible system of supply must have been that of a high self-containment in his force, supplemented by local replenishment from the resources of the countries he traversed; Hannibal all but defeated the stubborn power of Rome, and held Italy in his hands by the employment of such methods; Julius Caesar won great provinces for the Republic by the exercise of similar supply principles, which made his forces self-sufficing; the great Turenne adopted them; and finally Napoleon exploited them most thoroughly. And these were the great captains of war. The speed and the high carrying capacity—even in an industrial age in which war's armament and needs have piled up enormously—of the mechanized vehicle once again allow of a return to the exercise of mobility in war and of independent manœuvre, if these qualities be but exploited.

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[1] Ibid.

Mobility, being the first consideration of the mechanized formation, it must steer a course between the Scylla of a lack of essentials and the Charybdis of a superabundance; for as a man may die equally from a surfeit of luxury as from a lack of life's necessities, so in the same way mobility can be killed equally by an excess of supply as by its lack. The question then follows inevitably: how may a standard necessary to modern civilized warfare be maintained, and yet tonnages be kept down?—for the field of its requirements is so vast, its needs so complicated. The matter is one of such importance in its bearing on mobility, that it will be dealt with specially at length in a succeeding chapter. But to continue. Self-containment in the formation, as a principle of supply, should be exercised in every way possible: it should be extended to the unit, and even to the vehicle itself; for the further down it is practised, the greater will be the formation's powers of dispersion and the more it will at need be able to dispatch units on detached missions. For the period of its determined mission the unit should be self-sufficing in its supplies and stores, and in its repair and healing facilities. In our mechanized unit, even the soldier's cooking should be decentralized in the field, so that the vehicle can rely on itself, if detached from its parent unit. Then the distant patrol would present few cares, and a desert would lose half its terrors. A junior commander would be less trammelled than he is to-day by the constant bugbear of maintenance, dependent as he is on the thought and efforts of others. The Napoleonic division took with it its tailors, bootmakers, and other tradesmen, its food and its ammunition, and even a mill for grinding its corn; and we should endeavour to get back to its decentralized simplicity, when the squad cooked its own rations on its own camp fire.

Let us pause to note how Xenophon, a master of mobility, instructs generations to come in this business of a force's self-sufficiency.[1] He would have a force fully and carefully equipped with all its requisite warlike stores, and it should live by skilful requisition of the local resources; but should the land be barren, it should be prepared to be self-sufficing in natural supply also—he suggests as much as twenty days' provisions being carried in the trains. Nothing but war's essentials, nothing but bare necessities, is to be carried. So wine finds no place in the ration scale; the soldier is to live hard, and so his blankets are to be kept to a minimum; even provisions are to be subjected to a rationing in weight, and so he recommends condensed and concentrated foodstuffs, such as salted meats. Everything possible to keep down the accompanying transport is to be done, and to take advantage of local resources units are to carry hand mills. The unit is also to be able to do its own repairs, and for this it is to carry a proportion of tools, axes, shovels, timber, and leather; while for expert repair there are to be blacksmiths, carpenters, and shoemakers with it. Indeed, the whole picture leaves an impression of self-sufficiency very like what history records of the Napoleonic division or of the Roman legion, as the latter is described by Vegetius in his *Epitome of the Military Art.*[1] In the latter the legion of the later empire is shown as self-contained for many days in stores and supplies, besides having artificers of various trades and being equipped with mobile repair workshops.

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[1] See his *Cyropaedia* and *Hipparchicus.*

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[1] Of Vegetius, and this, 'the only comprehensive ancient treatise on the art of war which was written in Latin,' Spaulding in his *Pen and Sword in Greece and Rome* says:

'The leading soldiers of the Middle Ages carried him in their saddle pockets . . . half a dozen printed editions appeared before the end of the fifteenth century. The "Epitome" . . . shows the Roman system . . . and it was one of the main channels through which knowledge of their system was transmitted to Machiavelli, Maurice of Nassau and the other military reformers of the sixteenth and seventeenth centuries.'

Its contents must have been known to Gustavus Adolphus. How far did the legion's traditional supply principles, which Vegetius describes at the end of the fourth century, govern those of the great Swedish captain?

All the mechanized formation's requirements in supply in all kinds for the determined period —the Napoleonic division could live on itself for twenty-one days, and the legion for a month and a half—must be borne, either by the fighting vehicle itself, or by its accompanying transport; and clearly, the more the combatant vehicle itself can carry, the less will be the accompanying tonnages to be borne by the non-combatant portion of the force, and consequently the greater the manœuvrability of the whole. Sherman, famous in the American Civil War for his mobility, said[1] that every pound carried by the soldier meant an enormous relief to the train—and his is good advice to-day when, in the fighting vehicle, we have so powerful a soldier. It is the train, the accompanying transport and its size, which hamper the fighting formation; and for mobility its size must be kept down. All available space should be devoted to the carriage of the primary essentials for mobility, those which ensure continued movement, petrol, lubricants, spare parts, and food, or Class I Supplies, as they might be termed in the American forces. The mechanized force stands or falls by the mobility it attains, for this is its reason and purpose; and should the valuable space of its transport lorry be filched, officially or unofficially, to provide added comforts or ample provisions and luxuries, then mobility must inevitably suffer. Julius Caesar, luxurious young aristocrat though he was, and riding to power, as he did, on the shoulders of his legions, was nevertheless adamant in his great campaigns in Gaul on the question of the supply scales of his legions, and the Roman lived hard. Nothing but the bare necessities were allowed him, when he took the field.

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[1] See Sherman: *Memoirs of General W. T. Sherman.*

A Return to Simplicity necessary

A reduction in the supply tonnages necessary to a force may be achieved (*a*) by the reduction of man-power, and its replacement more fully by the machine; and (*b*) by a reduction, during active operations, in the standard of the soldier's living. (We may in passing note that here, wrapped round a military virtue as old as time, is an elementary principle of supply, although one practised as little to-day as the virtue itself is in evidence.) The first of our alternatives, we have already dealt with. Is the second possible to-day? Can the scale of the soldier's comforts be reduced? Or the variety of his rationing? For it is *his* clothing, *his* equipment, *his* rations which, when he fights in great masses, pile up the tonnages and swell base installations; and *his* supply which contributes so largely to the present shackles which supply fastens on the combatant formation and its strategy. But civilization's children demand a high standard, and in the little matters, so intimately affecting and so important to the soldier, is a return—if even for those times only when the machine must be exploited to the full of its powers—to harder ways and earlier days possible? We may reasonably assume that, notwithstanding the immense power and mobility inherent in a mechanized formation, there will not be a continuous call on its activities. The fatigue of its crews will necessitate intervals of rest; the wear of its vehicles periods for overhaul; and, possibly, its supplies and stores a complete refill. The fortified town, the strongly held forest belt, the picketed river line, the mountain chain, or a powerful trench system, will all enforce likely occasions for the involuntary slowing-up of mechanized mobility. Such will be the times, and such the occasions, when the fighting vehicle may have to stand off and lick its wounds, while the work of advance is carried on by the more slowly moving and older arms. And such also will be the opportunities offered to supply to move up to a more intimate contact with its consignees and to furnish them with all those extra accustomed needs of the modern soldier, which, however, his new-found mobility must label as luxuries and deny as impedimenta.

To-day our super-soldier, the fighting vehicle, may carry on its back a much greater proportion of its needs than its predecessor, the foot soldier, was able to do. Yet even its capacity as a weight-carrier is limited; and every spare inch of its valuable space, or in that of its accompanying transport, must be devoted to carrying its stores of motivity. The trans-Saharan motorist carries little in the way of creature comforts within the small compass of his chassis, but much of motivity supply. When, however, the call for mobility is not urgent, the objections to the 'incubus of supply' cannot carry the same weight; and it will be the periods of immobility, so far as the mechanized formation is concerned, which should permit its soldiers to return temporarily to their normal comforts and ample provisioning, their fresh meat and bread, their extra blanket, the ground-sheet, the change in clothing, the hot bath, and all the little luxuries of the canteen.

May not the cult of the soldier's comfort, perhaps, be overdone? By this it is not implied that, when in barracks or garrison, all that is possible should not be done to make his lot pleasant, or to enliven the routine of his days; but, when on manœuvres or field training, the closest imitation of war which peace affords, is it necessary that his amenities should bulk so large, or his comforts be so studied? On manœuvres, at his main halting places, he finds—and is not surprised to find—a canteen, already erected for his convenience; his several blankets he comes to look upon as a normal necessity; the deprivation of a second ground-sheet would be a calamity; rain or inclement weather are often pleaded for shortening his sojourn in the open; and his supply services arrange for him a diet-scale little different to that in barracks—in fact, they are frequently allotted a neutral role and so the more easily effect their purpose. Wherever he goes, supply, as a gigantic ponderous snake, follows him, to administer to his slow-moving needs. Are all these things really necessary?—they cannot be conducive to mobility. The morning shave, a good turn-out, a well-appointed meal, are all shibboleths ranking more highly than a quick get-away or a diminished transport; and comfort and appearance qualities more highly valued than frugality and mobility. He who can arrange for the most comfort in the fictitiously adverse conditions of peace manœuvres is always certain of some admiration; and, if on a large scale, perhaps even kudos. The old *cliché*, 'Why be uncomfortable, when there is no need for it?' provides the all-sufficing excuse.

Is the modern attitude not 'Away with the old soldierly virtues of frugality, hardiness, and endurance?'—so long as the soldier is healthy, clean, comfortable, and a bit of an athlete; and his animal glossy and well covered. To-day, comely Athleticism stands on War's pedestal, where once lean Endurance did. The ancient Greeks were renowned for their prowess in sport and game; but, as a nation, they never attained to the grim hardiness of the Roman. And so to-day —the praise of games is sung, the benefits of sport are lauded; while hardiness goes out of fashion, and frugality falls in disrepute.

The great authority, Gibbon, commenting on the eventual decay in Rome's armies, curiously observes of the military order in general that 'its modesty in peace, and service in war, is best secured by an honourable poverty'.[1] We find the same note sounded centuries later in the soldierly principles with which the German officer of the '70's was inculcated. In an official address to his army in 1874, the then emperor wrote:[2]

'The more general the spread of luxury and comfort, the more solemnly is the officer confronted by the duty never to forget that his honourable position in the state and in society has not been gained and cannot be maintained by material wealth. Not only does an enervating mode of life damage the combatant qualities of an officer, but the pursuit of gain and comfort would dangerously undermine the very ground upon which the officer's position is built up.'

That such principles had been practised, and were lived up to—officially, at any rate—under active service conditions, may be seen in the fact that in the campaign of 1866, among the very small amount of battalion transport permitted, one wagon only had to suffice for all the impedimenta of the unit's officers. The traditional qualities of simplicity of living and hardness of body, which in the soldier of civilization have contributed so largely to mobility, find their counterparts in the barbaric warrior of uncivilized lands; but with him, more often than not, they are the fruit of climate, poverty, and an arduous struggle for survival. The latter is possessed of them by virtue of his environment; the former, only through a studied self-denial or an instructed habit.

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[1] Gibbon: *Decline and Fall of the Roman Empire.*

[2] *Verordnung über die Ehrengerichte des Offiziere im Preussischen Heere*, 2 May 1874.

It was the possession of such qualities, their endurance in the saddle, their ability to subsist on little food and to resist thirst, which enabled Lawrence to exploit the Arabs of the Hedjaz and through their operations to display a mobility but rarely seen in war. He might have assured to them the added equipment and the ampler ration of the West; he might have organized their supply on professional lines. But he refused —he would have lost mobility. Two—and perhaps in this age the most striking—of the qualities of this great and unconventional leader were his indifference to comfort and capacity for endurance: he could beat the hardiest of desert Arabs at their own game; he could outride them, use less food and water, and bear greater hardship with less sleep. And he trained himself to do it. As a personal exemplar of these soldierly qualities, he stands out refreshingly in an age where supply, in her lavish administration, tends to enfold the soldier, till all movement must wait on her word.

If, in the field, mobility is to be recaptured, and its ways of thought engendered, tradition—a tradition, incidentally of comparatively recent growth—must submit to the cold light of fact-finding, and the soldier re-learn the ways of self-denial. Let us turn back the pages of history, and look a little at the soldier of those times when strategical mobility was high; for war and its practice are not wholly confined within the bounds of modern doctrine, nor its wisdom necessarily greatest in the epoch in which we live. Rome's legionary bore a load considerably heavier than that of the soldier of any modern army, and yet he was expected to maintain a daily average of twenty miles in six hours. Modern armies of the last hundred years can show no figures consistently to compare with these, although Napoleon's soldier approached them. The latter marched to Moscow with little or nothing, besides his great-coat to keep him warm, and his officer pillowed his head on his saddle, or where he could. To-day, blankets and a ground-sheet are transported for the soldier, while the officer must have his big roll of bedding. In the Peninsular War, bread or biscuit, meat, and an allowance of wine or spirits, sufficed for Wellington's tough soldiers;[1] but to-day, the official ration comprises fourteen foodstuffs, and in the Great War as many as forty-three had to be supplied. In the years prior to the Great War, the supply organization was built up largely with a view to ensuring the daily supply of fresh meat and bread; yet in the last two years of the Boer

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[1] See Fortescue: *The Early History of Transport and Supply*.

War, the soldier had to make do with bully beef and biscuit.

Simplicity of habit, poverty of comfort, and frugality of provisioning, though in ill accord with civilization's standards, are the progenitors of mobility; and a study of the history of supply reveals that this has invariably been highest when not only has the soldier been most inured to hardship, but when his provisioning has been meagre, or else won by the plunder of an enemy countryside. Now, mechanization, with its imperative call for mobility, clamours at our door; yet supply with its huge tonnages remains impregnably seated in its tradition. The Great War, a war of colossal immobility, has left this legacy; its outlook on supply persists; and scales, tonnages, and organization, all conform. In mechanized warfare, will such scales be justified? Or the tonnages be capable of transportation? The aeroplane becomes supply's peculiar and immediate foe, and so tonnages will have to be minimized and their cumbersomeness reduced. And this will affect the administrative tail of the formation no less than its rearward supply organizations, whether these be stationary or on wheel.

The value of the qualities of frugality and hardiness is in peril of being lost sight of; and their lack will, despite all the mechanical aids bestowed upon the soldier by modern industry, make mobility difficult to recapture. Yet they still hold the same value, and their exercise must tend to a greater capacity for self-containment in the unit and a consequent reduction in accompanying or following supply tonnages. Unfortunately, any steps in this desirable direction come up against two formidable obstacles: firstly, to-day's standards in living are high, and the soldier is habituated to them; secondly, the lorry offers him every inducement to avail himself of its tireless strength and capacity for the carriage of his comforts—and he is human. In addition, there must always be a natural tendency to please the soldier, and a desire to ameliorate the hardships of his arduous calling. Yet thus, tonnages increase, and non-combatant transport piles up. If the mechanized formation is to be assured the full mobility inherent in it, a fresh outlook on the soldier's standard of living, when engaged in operations of mobility, seems essential; and a return on his part to simplicity necessary. For should Frugality be spurned by the soldier, then Mobility, her twin sister, will also spread her wings and desert him, for her courtship has always enjoined self-denial.

A Summary

What shape has our mechanized and self-contained division now taken? Our ideal division will be a labour-saving organization, composed almost entirely of armoured fighting vehicles, automotive artillery, and an accompanying infantry reduced to a minimum, but powerfully weaponed. Its personnel, for the power they wield, will be small; and its small units will not be subject to mobilization on an outbreak of hostilities; but will be maintained on a war footing in peace, complete in all respects and ready to move at an hour's notice.

The division will move on wide fronts by many roads, though its cross-country powers of movement will be considerable; and its units will be dispersed over wide areas, both for ease of movement and subsistence on local resources. Both formation and unit will be as self-contained as possible in their supply needs and repair facilities, carrying, let us say, a week's supply; but this will consist of bare necessities, every inch of space left being devoted to the carriage of stores of motivity, which will be borne by the fighting vehicle or in its regimental transport. Thus, the formation's transport will be kept to a minimum.

Our division has broken free from the shackle of the horde army's supply system; it imitates the excellencies of the Roman legion and the Napoleonic division; and approaches the ship in its independence of manœuvre. It is an ideal—impossible, perhaps, of attainment. Nevertheless, it has been based on a supply system formulated logically from the salient characteristics of its warfare, dispersion and speed; and on the primary qualities of its vehicle, mobility and carrying capacity.

Replenishment of the Division by Convoy

To maintain a mechanized formation as a force in being, and to ensure its power of continued movement, its replenishment will best be effected by a long-distance through convoy.[1] The word may conjure up a formidable picture of, perhaps, miles of vulnerable, slowly moving, animal transport on the North-West Frontier of India, or maybe, a *pavé* road on the Western Front in the Great War congested with lorry columns of equidistantly spaced vehicles. Here will be nothing like that; for the convoy's traffic will have to run loose at speed, like civilian traffic does, when its time for movement comes; and its vehicles will have to go straight through to its waiting consignees. They may move in irregular clumps, or individually; but any form of columnar militarily controlled movement will be impossible. It will entice the hostile aeroplane to attack, and lead to congestion and slow average speeds. To ensure that traffic does run loose, it is conceivable that, so far from concentrating transport, before it moves off, in accordance with past custom, units may be dispersed to preliminary rendezvous in an area surrounding the near end of their journey, so that their vehicles will arrive on the main supply route sufficiently dispersed.

Administrative movement of this kind will clearly be possible only provided that the safety of the freighting traffic is guaranteed from raiding land forces, particularly those mechanized. But this connotes fronts which are advancing or else strongly held; and flanks, assured by strong natural obstacles to enemy penetration, such as a sea coast, a mountain chain, or a great river, or else strongly held by outlying forces while this vital traffic is moving. It would seem that, ahead of such administrative movement, mechanized combatant movement in the future must be visualized as movement towards some quarter of the compass on a broad front—the semi-independent speeding of dispersed battle squadrons—across an area with flanks set widely apart from each other; rather than, as presented in the past, as columnar marches by one or more roads towards some primary objectives. We get area movements, as fleets move; rather than linear movement, as armies have marched.

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[1] This might well be born from the present Supply Column.

The convoy's two enemies will be the hostile aeroplane, which will be on the watch to intercept its vital supplies; and the armoured raider which has managed to slip through the wide meshes of the advancing fleets. These, however, by their widely dispersed advance will ensure it a measure of security, although this will be nothing like that given in the past by the advance of large man-powered forces, which inundated a countryside. So the convoy's zones of safety will be either at its starting-place, or else in the shadow of the formation it is serving. It will, on occasion, trust for further immunity from attack, while on its journey, to careful route selection, concealment by mist or darkness, its own speed, but above all to its dispersion. For military traffic, when dispersed on the road, may be mistaken for civilian, from the air; and, even if discovered, would not present a very remunerative target to the hostile aeroplane. Control of the convoy's scurrying traffic will be by wireless, or by road telephones; while aeroplanes may escort it, to guard its progress from interruption and to indicate its best and safest route.

The traffic would move every few days, say, at weekly intervals, and would carry a refill for its formation of a further agreed self-containment period. On the whole, the tonnages which would have to go forward would be considerably less than those represented by the daily lift of the man-power division of the Great War, if this were multiplied by the number of days in the period;[1] and the more the formation lived on the country, exercising the supply principle of local replenishment, the less would be the periodical lift of the convoy. Periodical supply by convoy would mean discarding a fetish long held in reverence: that of the daily arrival of the ration. But with its going will also go supply's main shackle on mobility.

The presence of important convoys on long lines of communications may often induce an opposing commander to hold or entice his opponent forward, the better to make his main attack on his vital supplies in rear, just as 'Nelson in 1798 organized his fleet in such a way as to contain rather than destroy the enemy's battle squadron, so that he might provide for an overwhelming attack on the transports'.[1] Still, the distances covered and the speed of movement may of themselves constitute safeguards for the supply of the force ahead; for where a line of communications becomes in effect convoy traffic speeding occasionally at irregular and predetermined times, over a long distance, to talk of cutting the line becomes absurd. Pemberton's attempt to cut Grant's communications, when the latter made his final and successful advance on Vicksburg, proved abortive, for none materially existed. Grant had, in opposition to the advice of many of his well-wishers, determined to march with his force self-contained, and to discard for the period of the operation the normal maintenance system of supply from the rear. In 1813, all the raids of the Allies on the lines of communications of Napoleon's distant armies failed for similar reasons to bring his forces to starvation; for his successive bases on the long march to Moscow were at great distances apart, and his divisions were highly self-contained and were living on the country.

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[1] See table on page 319, for comparative details of the supplies necessary for a traditional formation, and also the same formation mechanized.

The capture of a convoy, however, or the

[1] Corbett: *Naval Operations.*

destruction of a base may well have disastrous results for a mechanized force, for this would mean the loss of stores of motivity on which its movement is founded. Supplies so vital will undoubtedly draw attack, and it seems not unlikely that, as in pre-Napoleonic times, war's strategy will once again largely revolve round the attack, or its threat, on supply's bases and movement. In the sixteenth, seventeenth, and eighteenth centuries, the baggage train or the rolling magazine were the stomach of a force, which in practice was often little more than a strong escort for its accompanying supplies. And all centred round the safety of these. Further, as forces were small and marched *en bloc* on one or perhaps two roads, their personnel was scattered down the route to guard their valuable train; for the loss of this was deemed more of a calamity than even defeat in battle. But from the beginning of the nineteenth century, and particularly after 1866 when the railway facilitated its movement, man-power grew till its masses could so inundate the country of their advance, that their following supplies had automatic protection behind the advancing screen of troops. So the attack on the convoy, on administrative movement and its bases, behind an army, fell into disuse as an operation of war until the advent of the aeroplane, which has once again brought it into prominence and made it an operation of value. And nothing carried in a supply column of the past, or stored at a base, could ever have been so vital to a force as is petrol to-day. Moreover, the dispersion of mechanized forces and the distances they cover will afford opportunities for bold attack on the vital traffic they will be so dependent upon.

Fleets manœuvre round each other like fencers do, and ships may be provisioned anywhere, even behind an enemy force. On land, it has been only the land force's auxiliary, the aeroplane, which in its three-dimensional movement has been able so to circumvent an enemy; and it operates like the long-distance convoy, in going straight through to its consignees. It will in the future, as it has already shown, be of the greatest value in provisioning far-distant or isolated units, or in temporarily assisting in maintenance when normal supply methods have broken down. During the operations undertaken in 1932 by the Iraq Government to suppress Sheikh Ahmed's revolt in Kurdistan, supply by air was notably effective when, owing to enemy action, supplies accompanying an Iraqi column were lost and when the hiatus in ground supply so caused had to be filled. An example on a larger scale was furnished in the recent Japanese operations in Jehol, when Japanese formations in the advance towards the Great Wall were transported in lorries and in consequence outran their following supply. The situation was adequately met by an air transport unit which, during a total of 1,100 flying hours, transported 100 tons of supplies and evacuated 350 casualties, besides carrying on occasion combatant personnel. Again in the Italo-Abyssinian War during the big battles in the Tigre, the Italian air forces on several occasions provisioned large bodies of troops for days at a time, so permitting them to move at distances, or over country, where normal ground supply was ineffective. There can be little doubt that for mechanized operations of dispersion, distance, and speed, supply by air will be increasingly used, where normal supply systems fail.

The Mobile Base

From where will our convoy traffic run, when the distance between base and force grows too great for adequate maintenance? Some form of intermediate *point d'appui* is necessary. But of what kind will it be?—for the menace of air attack, coupled with the great mobility of the mechanized vehicle, must dismiss as an impossible conception any idea of a fixed railhead or advanced base. The Roman legion, all through the many centuries of its existence, made it a cardinal rule to entrench its every camping place, when in hostile territory. The camp formed its strong, defensive, temporary base from which it struck or to which it could retreat if defeated, besides being a repository for the legion's heavy impedimenta and sick, when it wished to undertake a light operation of speed. At the end of the march, down went the Eagle to mark the camp's centre, and digging commenced; and no light digging at that, for 'a wall three feet high, with a ditch nine feet wide and seven feet deep, is spoken of as a light entrenchment'.[1] And the longer the stay of the formation, the more strongly was the camp entrenched. The principle remains, and may be seen in the perimeter camp used in modern colonial operations; the perimeter camp—the temporary and mobile security of a moving force—is commonly used in operations on the North-West Frontier of India and in the West African bush.

Let us turn for a moment to naval practice. Mahan says: 'Control of a maritime region is ensured primarily by a navy, and secondarily by positions suitably chosen and spaced from one another upon which as bases the navy rests, and from which it can exert its strength.'[2] In the same way, progressive conquest or control of an enemy territory could be effected by dispersed forces based on conveniently sited bases; but these, unlike the naval base, would first have to be made good in the face of enemy opposition. A modern authority, writing on the subject, says: 'The advanced base . . . must be mobile; it must be able to shift its position; for though when possible, it will occupy a road or rail centre, it will not always be able to do so, since in area warfare it may at any moment be attacked from any direction.'[1] There is nothing new in the idea of a mobile base: the naval aircraft carrier, protected by its fleet, is a floating mobile base for the aeroplanes it carries; and the Boer wagon-laager is another example. When the early Dutch *voortrekkers* in South Africa moved northwards and inland with their families and possessions in search of a new liberty for their way of life and new lands to dwell in, they came to the country of the Basuto, Matabele, and Zulu. There, at the end of the day's trek, the wagon-laager would be formed, the great living-wagons being drawn up in a square or oval and then linked together. It formed a defence by day or night against surprise attack, a repository for the community's possessions, and a strong place from which the mounted men would sally out—it was a mobile base.

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[1] Spaulding: *Pen and Sword in Greece and Rome.*

[2] Mahan: *The Interest of America in Sea Power.*

The I.C. engine can again come to the soldier's aid. In our army there exist a variety of mobile administrative units—in fact, all forward administration is now on wheel—Corps Field Parks, Army Field Workshops, Field Ambulances, and the like, ready and able to form the nucleus and substance of the forward mobile base for a formation. This could be defended easily, planted where necessary, and moved at will, although it would not in virtue of its static functions move frequently like the formation it serves. The idea of a large organization on wheel moving and then bedding down for a period may appear novel; but should the reader care to refer to the

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[1] Fuller: *On Future Warfare.*

Commercial Motor of the 18th of August 1933, he will there see described a mobile circus which is transported for long periods at a time by a fleet of about 280 vehicles of several different models. It moves from 120 to 250 kilometres in the day; is maintained by its accompanying machinery and spare parts; and provides entertainment, guaranteed and scheduled in advance. In the Royal Air Force, ground organizations, other than depots, are a 100 per cent mobile on their own transport, an example being the Aircraft Park, which is a mobile organization for the carriage and distribution of stores and an intermediary between the squadron and a rearward immobile base.

Several such mobile bases as we have outlined, even though sited in forward areas, would minimize the aeroplane's threat to administration; and one of these on each main supply route would 'service' the formation or formations advancing by that route. It can be visualized as an administrative area, chosen for reasons of strategy and on account of the natural facilities for concealment available, and relying for its immediate defence on its administrative personnel and on the reinforcement reserves of combatant personnel it would normally hold; it may be considered as an advanced base on wheels. It would form the first and foremost base for supply; it would constitute a land dockyard for the repair and overhaul of vehicle casualties which were serious; it would furnish facilities for the temporary care of the wounded; and, lastly, it would serve as a harbour in an immediate sense for its formation, should the latter suffer disaster and have to fall back.

The mobile base would carry the lightest of stocks for the maintenance of the force it serves —no more, say, than a week's supply at the outside; and, with the exception of an emergency reserve of about two days' supply, the principle to be aimed at would be the lightest of floating stocks compatible with the tactical situation, and a quick turn-over—the principle of the large modern departmental store. In it, above all things—and preferably limited to them, if a very high mobility were in demand—should lie stocks of motivity stores, those which assure the continued movement of the vehicle, such as petrol, lubricants, spare parts, and rations. Other lesser necessities, such as reserves of ammunition, armament spares, in fact battle stores, might also be advantageously carried, but in much lesser proportion. Here also would be located the percentage reinforcements of fighting vehicles and personnel.

The presence of an advanced mobile base would mean that the formation, while exercising the principle of self-containment, would not be overburdened with an accompanying transport so large and unwieldy that it needed an undue proportion of the formation's effectives to guard it. It would be the habitat for a proportion of the transport which at present plies up and down the supply route, congesting it between railhead and force; and within it would be gathered the bulk of the emergency reserves of petrol and possibly ammunition now borne in divisional petrol and ammunition companies, which are an integral part of the division and on the contents of which during periods of rest or tactical inactivity there is little call. Such valuable and dangerous supplies might well be better in the static security of a mobile base, awaiting a demand, fifty or even one hundred miles in rear—a long distance seemingly, but little when viewed in terms of motor-car travel.

The mobile base could also, though its primary function must be the maintenance of mobility, act as a transit area like the railhead of to-day for other and less essential stores demanded during periods of inactivity. As mobile operations gave place to static warfare, the base would move forward, if needed, to exercise a more intimate liaison with its force; and then doubtless administrative movement would gradually assume somewhat of the form it took in the Great War. In the planning, however, of any administrative organization, it must be wisdom to plan rather for the greatest demands which might be made on mobility and elasticity, than for anything less; for it is clearly easier in an emergency to slow down, rather than speed up an administrative process.

Any idea of progressive conquest, the normal work of the traditional division, has up to now been held to be outside the scope of a mechanized formation; but the exploitation of the latter's power of self-containment coupled with the support of such a mobile base as we have described would remove its present and stultifying disabilities, and enlarge its usefulness. The mobile base would give it the necessary speedy backing and punch.

An obvious criticism to the proposal for such a base, and so useful a pivot for administrative movement, would be that it is very much 'in the air'—far away, and obliged to rely on its own defensive measures in the midst of a hostile territory. The critic, however, still thinks in terms of march distances, forgetting that to-day sixty miles is but a matter of two or three hours' travel at most. He forgets also that it is the widespread manœuvre, speed, and power of its mechanized formation that in the main would constitute its guard and guarantee its safety; its own defences of fire, trench, wire, and land-mine are only its secondary protection; and these would normally be subjected to attack only by weak raiding forces, which had managed to slip through the meshes of its own screening forces. An apposite analogy exists in the isolated naval base or port which, although heavily fortified, relies mainly for its continued security on the power of a fleet in being, which commands the adjacent seas and is based on it.

Replenishment of the Mobile Base

If the mobile base be stocked with non-essentials—and in a unit's opinion everything it may require is essential—or if it carry too heavy tonnages of essentials, it will cease to be mobile, and merely become a dump. To be acquisitive is a characteristic of human nature; it is certainly a besetting sin of both combatant and administrative unit; for both, if granted the opportunity, will amass stores and supplies (mobility being a virtue which can look after itself, when the time comes). After a few months of static warfare in the Great War, the unit invariably began to swell with accumulated stores and comforts; railheads similarly, instead of being transit areas, tended to grow into dumps; and mobile workshops and parks gradually grew earthbound with the increasing clutter of their constantly discovered new necessities. To avoid this very human failing in war, our mobile base must be kept at a minimum and be periodically replenished, as it becomes depleted. How will this be done? If a railway should form part of the system —that is if the hostile aeroplane allows it to be so—the base's refill will come from railhead; if not, then this must come from the main base.

Even if we ignore the aeroplane's very powerful threat to the railway and its traffic in future European warfare, its value as an instrument of supply in mechanized operations seems very problematical. Its use has, as in civil life, permitted the movement of masses of armed man-power in war; but in mechanized operations these masses will be absent. Moreover, to-day, the swift, large-capacity mechanical vehicle itself becomes the railway's serious competitor for the carriage of people and goods. As a supply route, the railway has many disadvantages: its itineraries are rigid; it cannot be developed in capacity without immense labour, time, and cost; stations, sidings, and platforms are necessary, and the denser the traffic the more of these are required—in brief, the instrument is powerful, but delicate to work and meticulous in operation. It cannot penetrate everywhere with its supply load, as the lorry can. So will it have the value it once did in operations where not only are forces widely dispersed, but where tonnages may not be so enormous that they demand its services? Only the future can show. If it should be employed, its railheads will have to be mobile, instead of fixed as in the past, on account of the air threat; stocks there will have to be held on train, even though 'locking-up' of stock be a transportation heresy. During the siege of Paris in the Franco-Prussian War of 1870–1, when Gambetta was endeavouring to raise and equip forces in the west and south-west of France for its relief, there were then organized railway trains, which were kept constantly under load, to serve the purpose of mobile railheads for various columns of troops. In 1914, during the early mobile operations on the Western Front, the same principle was implemented by the B.E.F. in two ammunition trains which were kept fully loaded and moved to those areas where ammunition expenditure was heaviest. The idea is embodied in the modern French *en cas mobile* also.

As an alternative to the railway, there seems no reason why tractor-drawn road trains, carrying as much as fifty tons or more, might not be advantageously used for road work between the main and mobile bases; and should suitable roads not exist, they can with modern methods be quickly laid where needed. An advantage of the road train, composed of two or more units, is its economy in attendant personnel, and in power units. In colonial lands, such as East Africa, where railways are few and distances great, the petrol-driven road train gives efficient service in the haulage of heavy tonnages. Again, modern machines have speeded up the technique of road-making enormously; and the dirt road rapidly surfaced by modern machinery will stand up to motor traffic adequately for a year or so. To the Italian in the Italo-Abyssinian War road-making was of the greatest importance, for on his roads depended his mobility; it was his reply administratively to the mobility of the Abyssinian, which was founded on his meal sack and on what he could pick up.

The Base of the Mechanized Force

In view of the air threat to administration, there will have to be, instead of one or two large main bases, several small ones, dispersed over an area, strongly defended against the air raider, and with their activities concealed from the air as far as possible. And besides decentralizing base activities in this way, the base itself will have to be organized so as to offer the least remunerative target possible. One of the means by which this may be effected is by a reduction in its size; but as size is largely dependent upon the man-power employed, every step should be taken to keep its numbers down. How may this be done? Let us lean once again on civil industry and its ways, to show us.

The base is a reflection of industry in its homeland, adapted to the business of war: it collects, stores, preserves, repairs, heals, and replenishes—all activities common to, and identical with, those of peaceful industry; and the modern labour-saving methods of the latter should be equally possible in the former. In it are grouped all those supply installations requisite to maintain an army in the field: depots for supplies, general stores, ammunition, and petrol; yards for Engineer and Transportation services; hospitals and workshops—besides the administrative necessities peculiar and personal to the combatant, such as camps. With the exception of the workshop perhaps, all these supply activities are greedy of man-power. The workshop has taken its place among war's multifarious activities late in time, and then it sprang full grown from the arms of industry; its principles and practice derive from knowledge won in a machine-powered age; within it the machine is everything, and the man is merely its attendant; and to its personnel, speed of output, planned repair, and mass-production are the mere commonplace of efficient routine. It, alone, fully imitates modern civil practice in its economy of labour.

How may such ends, desirable in themselves, and particularly so in view of the air menace, be attained also in those other supply installations at a base whose tradition has been that of man-power for the work they have to do? The military drudgery of depot, store, and yard—its 'brute burdens'—falls generally within two categories:

(*a*) the moving or carrying of material; and
(*b*) its normal handling for renovation or repair.

Both in the past have involved much muscular effort, large fatigue squads, and a consequent heavy expenditure in man-hours. For the workshop and its practice, a host of powerful appliances exist, and are used; but for the storehouse, the yard, the dump, or the hospital, power-driven labour-savers have relatively been non-existent. The ideas of the workshop or, in other words, ordinary commercial methods, have as yet little permeated their routine; and it is the adoption or adaptation of such ideas that is here advocated—the mechanical outlook, which instinctively seeks the appropriate appliance for the job in hand.

Let us take the first category. What can industry furnish for our military needs? Overhead, a variety of light travelling cranes permit the easy movement of heavy stores within the storehouse; while underfoot, Decauville or gravity roller offer similar facilities. In addition, to serve transportation, there exists a multitude of small, petrol or electrically driven trucks, barrows, and trolleys; and to assist further in this class of movement, there are many forms of commercial stillages, which are merely small, low, portable platforms on to which stores can be loaded at leisure, for later removal by a truck which raises the whole and carts it away. To eliminate labour and effort in the tedious work of storage, industry similarly to-day presents us with a host of different labour-saving forms of standardized and quick-working metal racking, which can be transported in the flat, and then quickly erected wherever wanted. Many another labour-saver might be quoted, of which the benefits have been hitherto ignored by the soldier, but space forbids. He who is gifted with the critical faculty and also the power of observation cannot fail to notice how, all about him, in almost every matter of minor domestic routine, the soldier lags behind the civilian in the economy of time and effort.

And now for our second category. It is in this, the humbler and still less-noticed branch of what we may term domestic drudgery, that the power machine and its possible benefits have hardly been considered at all: that province of the soldier's work where scrubbing, rubbing, and cleaning take up so much of a man's time; where work, repetitive in its movements of hand and muscle, has to be done daily; where so many man-hours are in peace lost to the trade of soldiering. Let us assume the spectacles of the modern industrialist, and pass in review the daily work of custom and habit. How many hours are spent on each of the hundred-and-one miscellaneous jobs which are done by manual labour in a storehouse, a hospital, or a barracks? To adapt engineering practice to such humble, domestic ends may cause the hardened engineer to shudder or the traditional exponent of spit and polish to explode; to the first it carries a taint of heresy; and to the second it smacks of sloth. But it saves man-hours. For example, the removal by means of electrical power, at high speed and with practically no physical labour, of dirt from the many articles which the soldier must daily use may appear, at first sight, distinctly unconventional; yet, in a fraction of the time now spent, rust can be scaled off, soot made to fly, grease removed, and dirt dissipated, metal can be polished, equipment be cleaned, and armament furbished up—and all by machines, of which the cost is relatively trifling, and the design simplicity itself.

Until recent times the tedious work of such routine had to be carried out by hand, and so it has happened that a multitude of laborious, but simple jobs, perfectly operable by power-machines, have swallowed up man-power and wasted man-hours. In base installations, in particular, where the administrative organization must of necessity be in a perpetual state of flux, and maintenance operations constantly changing in magnitude, time, and site, many a job, although susceptible to machine operation, has had to be done, whatever its magnitude, with manual labour. To-day, industry provides motor-contained machines, which can be quickly erected, or as easily conveyed wherever wanted; they take their power by cable from any conveniently placed power point; and they can be had in a variety of forms and in differing horse-power. They present an example of the increasing employment in modern industry of the self-contained machine which can be made to operate off a common source of power, but independently (and so economically) of others which may be in the same plant. Many are of a type which is simple in principle, consisting essentially of a spindle or spindles to which rotary motion is imparted by a motor, and on the ends of which may be quickly fixed any one of an immense variety of tools, cutting mops, bobs, grinders, brushes, and the like. There are yet other light portable appliances, embodying the same principle, whereby work may be done at any reasonable distance from the power point. To furnish the 'mechanical hands' desired for any particular operation, or set of operations, a complete industry exists; and the mops, bobs, wheels, brushes, and grinders turned out to-day are literally industry's hands—and they are legion.

It will have been noticed that the presence of electrical power has been taken for granted. This has been done advisedly, for, where a main base is likely to be sited there should almost certainly be a source of electrical supply; and there is no reason why in a future base electricity should not be universally used by its personnel to obtain 'power', in the same way as at present its use in the guise of light and heat is general. The use of such machines as have been described is common workshop practice, and all that is here suggested is the extension and adaptation of modern engineering methods to the humbler needs of the domestic routine of a base. The soldier's new swift transportation is consequent on his adoption of the power-machine; his weapons, in their utilization of the force of explosion, increasingly become power tools; but only in his domestic needs does he lag behind in the quest for efficiency and power. Unlike the business manager, he still thinks in terms of man-power, and every extra job or fatigue entails its inevitable demand for more men. To the soldier the labour bill has meant nothing—military power was built up of men—and so there has come no really urgent call for the machine and its help. In the hostile aeroplane of the future, however, will undoubtedly be found the compelling necessity for its services, and particularly at a base.

The Shackle of Supply Broken

In the system as used by great man-powered armies to-day, real manœuvrability has been possible only in the steadily dwindling distance between railhead and the troops, and all supply installations behind the troops have been immobile. The force has been tied and shackled by its umbilical cord of supply. But in the supply system outlined in the foregoing paragraphs as appropriate to the mechanized division, the mobility of supply organizations is highest in the fighting zone, diminishing gradually to the necessary immobility of the main base on coast or frontier. The umbilical cord of a continuous replenishment from the rear has been cut. And it should be noted how, from the basic attributes of the mechanized vehicle, its speed and its capacity as a load carrier—those for which it was originally designed—have logically followed mobility and dispersion, as the salient features of its formation's operations in the field; and how these may be adequately displayed only by the exercise of the principles of self-containment and decentralization in supply.

Strategical and Tactical Movement

Let us now consider, in relation to force-movement in the field, our two systems of supply: that to which tradition has accustomed us, and now in general use for the maintenance of great armies built up on man-power; and that outlined in the foregoing pages, based on the peculiar qualities of the petrol-driven combat vehicle and on machine-power.

The object of all force-movement in the field is briefly to find the enemy, to hold him, and to hit him. Somewhere or other he will be met, and will take up, or be in, battle position. And the latter may be overcome by being

(*a*) turned,
(*b*) enveloped, or
(*c*) penetrated.

(*a*) *Attack from a Flank*

In the first of these methods, attack, or its threat, is carried out from a flank, and is directed against the flank of the enemy's position or against his line of communications. The movement may, and generally does, involve certain difficulties inherent in the operation: long distances have to be traversed; the force detached is to a certain extent 'in the air', and must rely upon itself; it suffers the risk of having its own line of communications cut, and so becoming isolated from the parent force. It is an operation calling for, in a high degree, the qualities of mobility and self-reliance in supply. The Napoleonic division was particularly adapted to this type of strategical movement, owing to its mobility, and its practice of self-containment supplemented by forcible requisition from local resources; it could dispense with any form of continuous supply from the rear. Napoleon employed the detached force, one entirely separated from the parent body, over and over again both in the strategical and tactical fields, to attack or to threaten an enemy's flank or his line of communications. Both of these operations, whether tactical or strategical, are peculiarly possible to a fast-moving, self-contained force; but they become increasingly difficult, if the far-reaching, outflanking force has to be maintained continuously from its point of departure in rear. With forces maintained by the first of these supply systems Napoleon was enabled to manœuvre so often on interior lines in the midst of two or three hostile armies and then, striking right or left, defeat them in detail; but such independence of manœuvre is denied, or made extremely difficult, by a supply system such as maintains the modern man-power army to-day. One has but to think of the B.E.F. at the Battle of the Marne, when it drove ahead into the gap left between the armies of Von Kluck and Von Bulow; and then to consider what might have happened—it is an interesting speculation—if that force had been so constituted that it was self-contained for the period of its battle operation, if it had been on Napoleonic lines.

Before the advent of the I.C. engine, the possibility of a modern man-power force carrying out a long-distance flanking movement, as a detached operation, had become too hazardous—even if the lack of mobility did not forbid it—on account of its absolute and daily dependence on the flow of continuous supply and administrative movement from the rear. With the arrival of the I.C. engine, however, the mobile independent manœuvre of an earlier age again becomes a possibility. The mechanized formation's great mobility, high fire power, large carrying capacity, and relatively small personnel, all point to the carrying out of tasks like this. Should the distance to be travelled become too great for adequate maintenance in technical supplies, a small mobile administrative base can be pushed forward, to act as an administrative link and a *point d'appui*. Conceive an adequately sustained operation of this sort brought to a successful conclusion—the I.C. engine presents such immense possibilities to a bold commander—and the likely fruits of it! The I.C. engine endows the operation with a quality of sustained power never known in the transient operations of the long-distance cavalry raid of the past; and of mobility, impossible of attainment by the overweighted man-power force.

(b) *Attack by Envelopment*

The envelopment of a defended position is, geometrically and in principle, a combination of the other two methods—the flanking and the frontal attack. A primitive example of it is the traditional battle advance of the Zulu impi, which took the form of a crescent, with the two horns advancing more swiftly than the central body. The manœuvre was used by Hannibal in 218 B.C. against the Romans at the Battle of Cannae. There, his smaller force of about 40,000, by extending its front intentionally to envelop the larger of their foes, who were 69,000 strong, won success, 50,000 Romans falling in the battle. In 1914 Ludendorf used the same manœuvre strategically against Samsonoff's army, and won the classical victory of Tannenberg, taking 60,000 prisoners. In his letter to his imperial master, he commented on the complete envelopment of the Russian forces, and registers his gratitude to his former teacher, Von Schlieffen. Perhaps the greatest modern example was the attempted envelopment, and rolling up against the Swiss border of the French armies by the German masses of invasion in 1914—the gigantic wheel, originally planned by Von Schlieffen, of which the right passed through Belgium and the pivot was on its left in the far south. The manœuvre has been a form of force-movement particularly suited to, and favoured by, the modern heavy man-power army. In this type of operation, the main line of communications remains protected by the wide advancing front, thus permitting, with little fear of interruption, the continuous maintenance from the rear so necessary to the sustained action of the force and of its distant wing.

It is of interest to note how since 1866, when the modern supply system based on a continuous replenishment from the rear was first devised and put into operation by Prussian staffs, envelopment by one or both flanks has been a favoured strategical manœuvre of the Teuton. The supply system works at its best in rear of the masses moving on these lines; but it could never have functioned amidst the swift mobility of a Napoleonic campaign. Envelopment by one or both flanks appears, in view of the present tyranny of supply, to be the one great strategical conception left to the modern horde army; and the actual forces of envelopment, those on the wing, would be the most mobile ones. To-day these would certainly be mechanized. We can rule the railway out, in view of the air threat, for the rapid carriage of such forces; so how, then, would our swift-flanking forces of mechanized troops be maintained? Moreover, the introduction of the I.C. engine into such an operation would mean a considerably added speed to the forces of envelopment. What might not have been the effects of the presence of two or three mechanized formations, buttressed by mobile bases, on Von Kluck's extreme right wing in 1914, in place of marching divisions, hard driven and poorly provisioned?

(*c*) *Frontal Attack*

The frontal attack on a strongly fortified position is the last resource of generalship. In the Great War, the defence dominated the attack, and particularly so on the Western Front, where it was a business of frontal attacks for four years. There, the machine-gun, coupled with the trench, invariably drove the attack to earth; and stalemate ensued, until the armoured vehicle eventually restored movement to the battlefield. Since 1918, the unit's fire power has still further increased, till to-day there seems little likelihood that unarmoured infantry will, even at the cost of huge losses, ever be able to arrive on an enemy position which has been systematically fortified. Only armour and the I.C. engine will force a way there, quickly and without unduly heavy casualties, and win what following infantry may later consolidate and hold. Parallel with this growth in the numbers and fire power of small arms, has also come an increase in the power and variety of the gun, until the armoured vehicle itself is no longer so relatively immune in battle. It must face, besides the more efficient field-gun, others specifically designed for its destruction. What is the I.C. engine's retort to this? More armour! or more speed!—which is armour. The former gap between hand-gun and cannon is dwindling fast; and the I.C. engine and its armoured vehicle have brought this to pass. Every increase in automatics and in weight of fire must accentuate the call for more armoured vehicles in proportion to unarmoured infantry—more 'mechanization' and less 'motorization'. Warfare must increasingly revolve round the duel between gun and armour, between tank and anti-tank.

If it be conceded then that armourless troops cannot advance in the face of modern fire, this must be left to the A.F.V. What is the likeliest method of its employment? At present, opinion, still swayed by the tank's role in the Great War, is divided on the problem whether light or heavy tank is the more suited to 'put the infantry'[1] on the position. Yet surely the real problem should be: what form the tank attack, released from the past trammels of an accompanying infantry, slow moving and highly vulnerable, will assume? And whether the first onslaught should consist of light or heavy tanks, or a combination of these? If we turn to the much greater sphere of naval warfare, we see naval formations composed of units of varying mobility, size, power, and function—battleships, cruisers, and destroyers—all co-operating. We might accordingly expect to see the last few thousand yards of the attack traversed at speed by swarms of light tanks, moving under the cover of smoke, backed by the heavier metal of the larger tanks, and supported by the fire of their mechanized artillery. Let us assume success and face the vexed problem: the A.F.V. may take, but cannot hold, a position; so how is the dangerous interim to be dealt with, while the supporting infantry advance to consolidate the position?

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[1] The *cliché* confesses their inability to arrive there of themselves.

Too often it is assumed that this supporting infantry must walk—it did so in the Great War. This traditional attitude is reflected in the 'infantry' tank. Its proposed introduction as a means of putting walking infantry on to a position is a retrograde step in the progress of mechanization; for through the practice of such a precept all the speed and efficiency of a first-class military machine is scaled down to the out-of-date standards of a man's strength and the pace of his marching feet. Should the infantryman not rather be given a form of transportation which will raise his standard to that of the tank; which will furnish the requisite strength and carrying capacity to bear forward all his needs in battle gear and food; which will, in brief, assure him a considerable measure of self-containment for the period of the operation? His tactical methods in the attack should be revised, if necessary, to conform with the powers with which the I.C. engine can now endow him—mobility and the capacity for self-containment. The infantry regiment is blessed with a First Line M.T. vehicle, inconspicuous, fast, and strong; and if the carriage forward of lorry-borne infantry be impossible, might this not, when occasion warrants, be effected by the use of vehicles of this sort? Only by means of the I.C. engine will the dangerous time-gap, between the successful tank attack and the arrival of the infantry of occupation, be adequately bridged. The necessity for fast movement, before the power of the defence has been completely liquidated, may even lead to the necessity for light armour on the transporting vehicles. It is conceivable that infantry and their supplies might even be carried forward in tanks, adapted or designed for these specific purposes. In the Great War, the supply tank was able on occasion to carry forward supply tonnages otherwise necessitating the labour of many men.

In the Great War, the problem of maintaining the momentum of the attack, once the crust of the defence had been pierced, was never solved. The soldier is so weak a carrier, his necessities so many, and his war burdens so heavy, that he must relegate his supplies to following transport; and these were never able to move forward fast enough to support and strengthen their hard-pressed consignees. To-day, however, the new super-soldier—tank, armoured car, or other I.C.-engined vehicle—has a high power of self-containment, and need not immediately depend on supply from the rear. Through this great quality, provided design exploits it—and this seems advisable even at the cost of some speed and armour—the continued momentum of the attack may once again be assured; for the assault will carry, up with it and in its units, everything it needs. By a more universal employment of the I.C. engine on the field of battle, the attack on a fortified position may culminate in operations of mobility, instead of in the stagnation of static warfare.

Chapter Thirteen

SUPPLY TO MOTORIZED AND MIXED FORCES

Supply to the Motorized Formation—Supply to the Mixed Force—As Mobility Slows Up—Italo-Abyssinian War, 1935–6

Supply to the Motorized Formation

We have seen earlier the supply system in vogue for the maintenance of man-powered forces; the attributes peculiar to machine-powered forces have been shown; and a system of supply appropriate to the mechanized formation has been outlined. We have dealt with the two ends of the bracket, the entirely man-powered force of the past and the entirely machine-powered force of the future; but what of the motorized formation? For many a decade this will undoubtedly be seen side by side with the two other forms of force-movement, although it can only be an intermediate stage in the transition from old to new—a stage in a process where military forces are changing over from muscular power, and adapting themselves to the power of the machine.

The trend in development of the machine must inevitably swing into line with the more advanced of these two policies; for, as we have said, the continuous growth in the power and variety of the gun will call for its antidote, armour. A modifying influence, however, in this swing of the pendulum to the left will be the necessity for retaining the unarmoured infantryman for the occupation or holding of military positions and for the purpose of subduing, or maintaining order among, a hostile populace. In the first of these, the trench or the fortification lend him armour; while in the second, numbers, individual contact, and the personal dissemination of authority, are necessary, and particularly so in the policing measures occasionally necessary in the many lands of a widespread empire. Despite the interest focused and the literature published on the subject of machine-powered forces, the fact remains that the bulk, the very great bulk, of armies to-day is composed of infantry—man-power. It remains the backbone of armies despite the growing doubt as to the unarmoured soldier's ability to storm, as he once did, a modern fortified position. Tradition has met Progress and, despite the lessons of Industry, puts infantry on wheels—and so motorization! It may be that, as fire power in the infantry unit continues to mount, as it has done so rapidly in the last two decades, so increasing the battle value of the individual soldier, his numbers will go down; it may be that the motorized formation with an ample man-power will prove so cumbersome in manœuvre that a reduction in its numbers must be made; or—and more likely—the difficulties of its maintenance, due to its large personnel, coupled with a desire for mobility, will force a reduction in its personnel. The further the reduction in its personnel, whatever be the cause, and the more its replacement by the machine, the closer will it approach the mechanized formation in principle.

At present, motorization draws its strength from the extensive use made of M.T. in transporting men and supplies during the Great War. A military writer thus records its development in France:[1] 'Ultérieurement l'organisation fut développé, et en 1918, elle embrassait l'ensemble des grandes artères routières en arrière du front des armées.' In the motorized division, however, we are back in principle once again to the horde army, but with its swollen numbers carried on wheel, assisted merely in varying degree by armoured or specialist fighting vehicles; and through the agency of the machine used thus extra assistance will be afforded to the railway to inundate an enemy's frontier with armed flesh. But its supply will be colossal, and its multitude of man-transporting vehicles will encumber the roads, as did marching men and animals in the Great War. Its mobility, derived from the power of the machine, will be nullified by numbers and their mass; for there the machine

[1] Allehaut: *Motorisation et armées de demain.*

will not be used to do the work of many, but merely to carry many. How will this colossus, part human and part mechanical, be maintained?

Years ago, Jomini wrote that the art of provisioning a numerous army in an enemy's country is one of the most difficult. And he never could have foreseen the additional liability of having to provision in fuel, lubricants, and spares a companion host of technical vehicles. The tonnages of natural supply for the heavy man-power engaged will need an immense transport which, in addition to that required for the large personnel, will call for an immense service for its maintenance and repair. It should be remembered that every mechanical vehicle added to a force means not only the addition of one and a half drivers to swell its personnel, but also the addition of approximately another mechanic away in rear for its repair and upkeep. And this is unavoidable, whether the vehicle be a 'mechanized' or 'motorized' one. But in the first case, it is a personnel-saving, fighting machine which we are so expensively catering for; while in the second, this is not so. Were the whole army motorized, at least 50 per cent of its strength would be engaged upon administrative work of some kind or other, and so not be available for the battle line. A British force in the field in 1914 was composed of roughly 74 per cent combatants, that is those whose function is pure fighting, and the remainder were administrative personnel; but by 1935 this percentage had fallen to 58 per cent, since when administrative services have continued to grow and grow. If it were possible to conceive the whole army as fully mechanized, then, although the relative proportion of non-combatants would be still higher, its total numbers would undoubtedly be less than if it were motorized. And from the supply angle, its maintenance would be considerably the easier; for it cannot be too often repeated that it is man himself who is so costly to maintain.

In implementing a policy of motorization in war, industry will be bled for vehicles, and these will pour into military hands, varying in make, model, and capacity, until the spare parts problem assumes dimensions even greater than it did in the Great War. The relief given then to supply services by the advent of the lorry will be absent; for they will have to catch up and deliver their loads not to troops marching slowly on foot, but borne instead on vehicles as fast as their own.

One of the lessons of the Great War was that the maintenance of a great force must take the form of a never-ceasing flow from the rear. Put its masses on wheels, faster though they be than feet, and is the supply position in any way different? Would not road congestion, if anything, be worse?—for masses of vehicles can more effectually block a road than can marching men. It may safely be assumed that systems of supply similar to those in use in the great conflicts of '66, '70, and 1914, would again have to be brought into use; that replenishments from the rear would be the supply principle implemented; and that once again the horde army, now on wheel, would be shackled by its vital umbilical cord of supply—to the detriment of all the mobility with which the I.C. engine can endow it. We get once more a picture of supply as it was during operations of movement on the Western Front, early in the Great War: roads and railways congested; inability to subsist on the country; supplies struggling to get forward daily over routes already choked by the vehicles of the combatants; enormous administrative installations in an elaborately organized back area—in a word, immobility, and moreover an immobility perpetually harassed by an ever-present menace from the air.

Another lesson of the Great War was that M.T. was best used in prolongation of, and not as a parallel and subsidiary service to, the railway. Will 'motorization' serve in the latter way? Possibly rail may be devoted to supplies, and M.T. to personnel. Still, whatever the method, the total tonnages to be borne will remain.

The difficulties in the movement of armed masses by M.T. may be seen from the following: experience in 1918 proved that 1,600 lorries possessed just about the carrying capacity of a double line of railway, but only on journeys up to sixty to eighty kilometres. Generally, too, the vehicle could compete with the railway for distances up to 100 and 150 kilometres, but not for anything greater than this, and the longer the distance the greater was its inferiority. The one adequate medium for the transportation of great masses of men and their supplies was, and still remains, the railway. But whether by rail, vehicle or on foot, the movement of masses of men will be extremely difficult under the threat of the aeroplane; and the latter will certainly be used in numbers, and to an extent that the soldier has never experienced. Its activities will be directed at his places of entrainment and detrainment, embussing and debussing, and deployment for battle, and generally wherever he collects in his numbers. It was the advent of the railway, with all its speed, power, and freight-capacity, which originally permitted the use, growth, and maintenance of horde armies; and, this being so, it is difficult to see the eventual benefits in ease of manœuvre and added mobility likely to accrue from their motorized movement. Real mobility and independence of manœuvre will be attained by the motorized formation in the corresponding measure in which it approaches the mechanized formation in its utilization of the machine.

Supply to the Mixed Force

We will now consider a form of force common to, and inevitable in, the present period of transition from muscular to machine power: that composed partly of marching, and partly of motorized or mechanized formations—a mixture of the old and the new. Armies to-day comprise some or all of these. Here, to be catered for by the supply services are three distinct forms of force-movement: firstly, that in which masses of men move on foot; secondly, that in which these masses will move on wheel; and thirdly, that in which a relatively small, but powerfully weaponed, personnel move on track or wheel.

Will marching men and machines move separately? The answer seems obvious—Yes! They cannot march together, for compromise in pace kills both. We might reasonably assume that in front there will go, as the old independent cavalry did, the mechanized formations, followed up as closely as possible by the motorized formations, while away in rear there will follow the marching masses by road or rail. If this should be so, then supply will be seen in two systems, working side by side, for the man-power formation, whether on foot or motorized, will certainly cleave to that now universally employed and embodying the principle of continuous replenishment from the rear; while the mechanized formation will call for some such simple elastic system as that outlined in the previous chapter, if it is to give of its best. With a supply system devised to meet its special needs, it will be equal to any task—a pursuit, an independent raid, a wide flanking operation, or even swift progressive conquest; while the motorized formation, in its supply system, must cleave to either that of the man-power past, or else, according to the measure in which it has replaced its man-power by that of the machine, it will approach in its supply systems that appropriate to the mechanized formation.

Let us assume, however, that our motorized formation is at full man-power strength, and let us suppose it to be dispatched on a far-reaching mission, for which its speed qualifies it. What actually will be its supply arrangements? Its large man-power will demand either continuous daily maintenance from the rear, and the normal system of staging echelons will have to be instituted, so shackling it to its starting base; or else an immense transport must accompany it, making it still more unwieldy. When it is realized, moreover, that fifty to seventy miles represent the greatest distance from base or railhead at which maintenance can be adequately effected, and that to-day this distance represents a comfortable day's travel for the fighting vehicle, the problem of ensuring any real strategical independence of manœuvre to the motorized formation appears insoluble. Again, such a system of supply as it would need demands the services of both railway and railhead, and the efficiency of these under the air threat is distinctly problematical. Is there any solution? Are more staging echelons of transport to be put in, to link up the fighting vehicle with its base? which may be either fixed or else perhaps a main body marching slowly on foot. Even if their addition ensured continuity of maintenance, would it still be possible to organize on the present model a secure and regularized supply route through what presumably would be an unsecured and hostile territory, and at such a speed that it did not trammel the distant force? The best possible in such a case appears to be that the motorized formation would have to move in long bounds, followed by intervals of rest to permit supply services to organize further extensions of their staging activities. It cannot have the power of independent manœuvre and sustained movement, untrammelled by supply, which is possible to the mechanized formation.

As Mobility Slows Up

We have in the foregoing pages suggested systems of supply peculiar to, or appropriate for, various forms of modern force-movement—mechanized, motorized, and muscular; and in European warfare all these forms may be operating at the same time in the same area of hostilities, and similarly their special supply systems will have been called into use. What, however, will be the administrative picture, when machine-made mobility is halted by the power of the defence, by the fortified position with its trenches, wire, pill boxes, mines, and formidable armament?—as may well happen after a few initial weeks of campaigning. If machine-powered forces cannot retain their requisite power of manœuvre, then mobility will fly the area of hostilities, and static warfare will set in; the manœuvre of the machine will give place to the trench fighting of the man. Let us—reverting to our picture of war as outlined in Chapter X—assume that a powerful defensive position has halted the onrush of the mechanized and motorized waves of invasion. Then the machine-powered forces must stand off, or fall back on the cover and security of the slower-moving man-power masses of invasion, following up and supporting them. Trench fighting becomes inevitable, and its one main purpose must be to restore again mobility on the battlefield by opening a way through the enemy opposition for the machine-powered forces. But while it lasts, the infantryman comes into his own, and military strength must once again be measured in man-power.

And for the maintenance of men in masses, there can be only one instrument of supply—the railway; and only one principle—that of continuous replenishment from the rear. Again, if we assume trench fighting and its long fortified lines, we must also assume behind these lines—as in the Great War—large administrative areas, whose security, subject normally only to hostile air action, will permit a scheduled and elaborate routine of supply. So in brief, so long as operations are fluid and action is based on the power of the machine, maintenance will have to be effected by systems based on the principles of self-containment and decentralization in supply; but when trench fighting sets in, or man-power is employed in great numbers, its maintenance will demand the well-known methods of the past.

The Italo-Abyssinian War, 1935–6

The Italian operations, particularly in the northern and main theatre of hostilities in Abyssinia, afford striking examples of supply systems devised on the spot to meet the needs of the different forms of force-movement employed. It will be seen how, as operations progressed, maintenance methods implemented principles of supply dealt with in the earlier chapters of Part I; and how particularly, once the power of the machine was fully exploited, the supply principle changed from that of replenishment from the rear to that of self-containment. The campaign, viewed from a supply angle, constitutes a milestone in the maintenance of armed forces in the field; and the lessons it presents to the student of administration may rightly be termed revolutionary in their break-away from the tradition of all but a century and from the universally accepted practice of general staffs. And this departure from precedent is the more remarkable, in so much as invasion was initially planned and, in its first stages, carried through in accordance with the well-established practice of the horde army; it started, and remained for some months, true to type; and then—tradition was broken, and its ritual discarded. Invasion was to rely on masses of man-power to achieve its ends; the advance was to be methodical, conquest progressive, and the whole sustained strongly from the base in rear. It was to be a colonial war scaled up to the standards of continental warfare.

In order to acquire colonial territories; to avenge the disastrous defeat of Adowa in '96; and to mete out punishment for a sequence of irritating border incidents; man-power was poured into the adjacent colony, and base of operations, Eritrea, via the port of Massawa on the Red Sea. Division followed division, till the total passed the quarter of a million mark; while to maintain its masses, a host of vehicles and a multitude of labourers for road-making and construction were also disembarked. Force, in terms of man-power, was to be overwhelming, so that the native population was overawed by the might and spectacle of its armed masses. Scarcely ever in any campaign had a local commander been so lavishly supported in his task as were De Bono and his successor, Badoglio, in Abyssinia.

The difficulties of the civilized invaders were first and last and all the way those of maintenance; supply was the main foe to be overcome by the Italian. And its difficulties were the greater on account of the large masses employed, for here was a theatre of war to which an ancient maxim regarding warfare in Spain might well have applied—that there small armies were beaten, while large ones starved. The invaders were confronted by all the conditions adverse to maintenance which are so common a feature of colonial warfare in a mountainous terrain. The terrain of their advance, the Tigre and Amhara country, consisted of a mountainous plateau with mountains up to 8,000 and 9,000 feet in height; it was barren of the supplies necessary to provision any large force, and had little water in it; there were few communications, and those but the roughest of mule tracks, following the serrated summits of ridges to disappear into, and reappear out of, steep valleys—tracks so bad that normally the traveller did not journey in the rainy season from July to September; and lastly, great distances had to be covered—distances exemplified by that of about 460 miles from railhead at Asmara, via Makalle, to Addis Ababa, the capital.

How did the invaders' maintenance services tackle this formidable proposition? And what was the administrative lay-out? Viewed widely from the supply angle, the operations fall into two distinct phases: the first, lasting from the opening of hostilities in the early part of October 1935 until the end of March, in which movement was based on man-power and governed by its limitations; and the second, continuing from March until the arrival at the capital on May 5th of the motorized Sabauda Division, which covered about 304 miles, and its two subsidiary columns. In this latter period, a high mobility was attained in the advance southwards through the power of the machine, coupled with the use of relatively small but powerful forces. Let us take each phase in turn, and note the supply systems employed.

Invasion was effected by three army corps advancing by three routes, the frontier being crossed on the 3rd of October 1935. These masses advanced with little opposition on the part of the enemy, and finally came to rest, holding towards the end of January 1936 a defensive line of some 800 miles in extent, with Makalle as its most southerly point. There then followed a prolonged check of the troops on the positions they were holding, which was mainly due to a succession of attacks by the enemy. But between the middle of February and the early part of April the invaders resumed the initiative, and there followed the great battles—round the defensive line—of Enderta, Tembien, Shire, and Mai Ceu, which crushed all opposition, so leaving the way clear for the advance southwards to Addis Ababa. By the beginning of April, about six months after they had crossed the Eritrean border, the invaders had reached Mai Ceu some 250 miles to the southward on their journey towards the capital.

The supply system of the advancing masses was a replica of that in the Great War. From the coastal base, Massawa, a railway and a motor road, about seventy-five miles long, ran to

Asmara, the railhead. Both the railway, which was of narrow gauge, and the road, which had numberless bends in it, rose some 7,000 feet to arrive at the railhead on the Eritrean plateau. Yet the railway, on which a train took five to six hours to reach its destination, was improved till seven trains a day were able to do the journey; and the road was improved until it furnished the main artery for the supply of the masses in the Tigre. By these two instruments of maintenance an eventual 'lift' of about 2,500 tons daily was achieved, the great bulk of it going up the road on lorry transport. From railhead motor transport, supplemented farther inland by pack transport where tracks were too bad, bore supply onward by three main routes, radiating towards Adowa, Enticcio, and Adigrat, severally.

For reasons of climate and congestion, Massawa became rather a base transit area than a base for stores, and Asmara took its place for this latter purpose, becoming to all intents and purposes the main base of supply. As the troops advanced inland, and motor roads were built behind them, so supply depots were installed and stocked farther and farther forward, until there were many of them ministering to the needs of the widely flung masses on their 800-mile perimeter of defence. These depots literally followed the road-making, and one was even sited as far inland as Quoram, about 250 miles from Massawa, and from where later mechanized invasion southwards was launched to complete the work of conquest. In fact, up to the time of the crushing defeats of the enemy in the series of battles which might well be called the Battles of the Tigre, supply depended on road-making, and the whole of the area with its many advanced bases and depots presents a picture not unlike that behind the trench lines on the Western Front in Flanders in the Great War. Road-making on a large scale was necessary to allow of the passage of the huge tonnages which all had to pass up the slender bottle-neck of the line of communications. Supply, particularly in the earlier stages of its transportation, had to be a never-ceasing stream, to maintain the heavy man-power engaged; and the supply principle exercised was that of a continuous replenishment from the rear. The necessary use of this system and the lack of roads were the causes of the slow advance, and when at times the call for mobility became imperative and the system failed, recourse was had to supply by aeroplane, or else the soldier's load was increased. The Abyssinian, on the other hand, needed no transport: he lived on his food sack, which he replenished from local loot; and in doing so, he was three times as mobile as the civilized soldier.

The second supply phase may be said to have commenced during the month of March 1936 when, from the huge reservoir of slowly moving and cumbrously maintained man-power, small motorized forces were launched to carry swift conquest southwards. Let us take one of these, and see how it was maintained—that which set out from Om Ager on March 20th to advance on Gondar. It was composed of lorry-borne infantry, armoured cars, motor machine-guns, mechanized batteries, and auxiliary services, and had a total strength of 5,000 effectives. There were 500 lorries, and the force was self-contained for thirty days. It moved through a territory largely unexplored and mountainous, and often even trackless; yet it completed a distance of about 220 miles in twelve days, and reached its objective. The lorry had made the civilized soldier self-sufficing; as his poverty, the Abyssinian.

An example on a larger scale of self-contained movement was the main advance on Addis Ababa by a motorized force consisting of a division and a brigade transported in about 1,700 vehicles. This carried with it all its supplies, and was self-contained for twenty days. It left Quoram on April 21st, up to which point a road had been built with great effort, and, though it had then to make its way over the worst of tracks, reached the capital on May 5th, having covered in that time nearly 340 miles. The same principle of self-containment was also exercised by a small motorized column of native troops, which earlier had completed 120 miles across a desert from Assab on the coast to Sardo; and it was further extended to the mobile ground organizations of the aviation services, which carried with them all their supplies for twenty days.[1]

It will have been observed how release from an initial immobility, due to large man-power masses and the difficulties of their maintenance, was eventually attained through the speed and capacity for self-containment of the motor vehicle. It is of interest, by way of contrast, to note how a similar release was obtained in the earlier British operations in Abyssinia in 1868. The conditions then were not unlike those outlined above: the terrain of the advance was the same in character; and the main problem which confronted the British commander was then also one of supply. From Zula, the coastal base, to the foothills a fourteen-mile railway was constructed, and the long line of communications stretched through Senafe, the advanced base, and Adigrat on to the objective, Magdala, 400 miles away. The invading force was approximately of the strength of a division, and its supply system was based on a partial self-containment of the force coupled with replenishment from the rear by periodical convoy. At Lat, however, south of Ashangi, on account of the slowness of the advance, which was due to difficulties of terrain and the cumbersomeness of the accompanying supplies, a flying column of 5,000 men, self-contained for fifteen days and with stores and kits cut to a minimum, was organized; and this covered the remaining distance and stormed Magdala.

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[1] See Polson Newman: *Italy's Conquest of Abyssinia.*

In the recent campaign, the power of the machine, both as lethal power-tool and as I.C.-engined vehicle, permitted the movement of real force; while in the earlier operations of the British, to attain mobility numbers had to be cut down and strength reduced.

Chapter Fourteen

PRIMARY STORES

Stores of Movement and Battle—Priorities in Supply—Petrol and Lubricants—Spare Parts—Food and Water—Reduction in Supply Tonnages

Stores of Movement and Battle

War connotes movement and weapons: the exercise of the first leads up to, and permits, the use of the second. In war, the soldier's maintenance and that of his fighting vehicle demands a host of items of every conceivable kind and complexity; but this, when analysed, resolves into two main divisions:

(*a*) Motivity supply, that is that which ensures movement. In the case of the man, this is represented by water, food, and fuel for its cooking; and in that of the vehicle, by its petrol, lubricants, and spare parts.

(*b*) War equipment supply, which fits, assists and completes the man or machine for their ultimate task—battle. It would comprise generally every form of supply other than that above.

The factors governing the radius of movement of a force have varied at different times and with the type of force employed. In the days of sail, the water and provisions carried limited the ship's range of action; but when coal replaced sails, and later oil-fuel coal, it was these rather than water and provisions which determined the length of a voyage. Similarly, the amount of water and food which could be carried, or found in the country traversed, governed the radius of action of a self-contained army; but to-day the radius of action of a mechanized or a motorized force will be determined by the petrol it can carry. The governing factors have changed, but they still remain the agents of motivity, and they are now peculiar to the machine rather than the man.

The war equipment supply of both man and machine may assist directly or indirectly towards the desired end, success in battle. The infantryman's automatic or the three-pounder shell of a tank represent direct power added to the man and the machine respectively; while the blanket or the camouflage net, through increased efficiency or protection, contribute indirectly towards the same end. All in their way go to strengthen the fighting organism. Yet the more powerful the first is made, and the more lavish the second, the less must be the resultant mobility of the whole; for each ton extra of these to be carried is a ton less of motivity stores.

Which ranks first in importance?—motivity supply or battle equipment. In the giving of a blow impact follows the movement of the arm and so does battle the approach march. But the infantryman unable to march, the cavalryman whose horse has foundered, or the crew with their tank 'dead', are alike impotent, so far as their functions go. It is related[1] of the Duke of Wellington, that he was once asked,

'What is the first requirement of a soldier?'

'A good pair of shoes,' he replied.

'And the second?' said his questioner.

'A good pair of shoes for a change.'

'And the third?' persisted the other.

'A pair of soles for repairs,' concluded the Duke.

He had placed the ability to move as the first of all urgencies. In the same way, the continued movement of his machine is by far the most important thing to the mechanized soldier: so long as it 'keeps ticking-over', all is well. If it stops, he cannot advance to fight, much less retire; if it becomes a casualty, he may be captured, starved, or killed—in any case, the crew and all their high fire-power are lost to the unit. The outstanding attribute of the mechanized or motorized force is its mobility, and so those forms of supply which ensure movement must necessarily take precedence of all others.

Priorities in Supply

Specialization in the carriage and distribution of military goods is overdue. It is the key-note in the handling of merchandise in trade and industry to-day: there, time, safety, price, and the nature of the goods, govern the selection of the transport medium chosen. In the vast field of military supply, however, there has been little opportunity for any differentiation of treatment. All supplies, with a few exceptions, whether petrol or clothing, food or harness, or forage or road-metal, have had one road and gone at one pace: they have travelled to the soldier up the bottle-neck of the line of communications; and the railway and the draught animal have carried them forward. Nor has the advent of the lorry altered the system appreciably. Moreover, the claims of armament have so completely overshadowed those of mobility that its necessities have set the pace of distribution for all.

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[1] From a conversation between Sir John Burgoyne and the Duke of Wellington.

If we examine the system—our own for choice—we find that, with the exception of ammunition, which must be automatically replenished as it is used up, and which has its own wharves, depots, railheads, and personnel, all supplies go forward from the base by a daily, scheduled 'pack train'. Occasionally, if the urgency warrants, a 'bulk train' may be dispatched, carrying a special consignment; and it represents the normal extent of specialization in distribution. Ammunition has arrived at a favoured treatment, though only within comparatively recent times, on account of its importance in the race for more armament and added power in war. In general, however, the method has been like that which was in vogue in the civil world before the railway arrived, when all goods and merchandise went by pack-horse or carrier's van and no other transport media existed. To-day, heavy goods, perishable commodities, luxury articles, and mails, all have their peculiar urgencies and claim their special forms of transport.

Will the demand for mobility in mechanized operations allow of the same standardized distribution of all the unit's varied requirements? Its special needs must inevitably demand a new categorization of stores, based on their relative urgencies; and those now obtaining and originating in purely departmental[1] practice must be shelved. We have already seen, as a fundamental principle of supply, that all the material wants of the soldier fall naturally and logically into one or other of two main divisions, motivity supply and war equipment supply; and we can use it to determine whether at any time any particular item, or group of items, should be given priority of treatment. The test is simple. Does it assist movement or battle? And in what measure?

Viewed in this way, the main necessities of the fighting vehicle, or of its unit, must rank in this order: firstly, petrol or oil-fuel, which give motive power to the whole organism; secondly, lubricants, which permit its use; and thirdly, spare parts, which support and buttress mechanized movement. Fourthly, comes ammunition; for, although food is the motive power of the man,

[1] See note 1, p. 130.

the machine's companion, and should seemingly come next, its immediate availability is not so imperative, on account of his ability to continue working on reduced or even on no rations. Also, where food may be found, there is usually also fuel for its cooking. Water, which may also be considered as a motive fuel for the man, can normally be ignored, as it is generally available everywhere. We will take in further detail each of these primary essentials to mobility.

Petrol and Lubricants

Petrol is the life-blood of the machine-powered force: it must always be immediately available; and its supply must be as certain as it is humanly possible to make it. To this end all else, if necessary, must be sacrificed.

How is it carried in the formation? And how replenished? To-day, our fighting vehicle carries sufficient petrol for two normal days' marches, and in addition there is enough carried in the formation's accompanying transport to ensure movement for a further day. Replenishment is governed by the principle that every unit shall have with it a sufficient quantity to allow for the operation of its vehicles over a circuit of fifty miles each day. The daily provision of this royal essence has to conform to the ordinary channels of distribution of supplies; and it has had to fall into place, among stores of a much lesser urgency, in a system devised to meet the needs of troops moving on foot.

If we are to exercise our principle of self-containment, as that most appropriate to a mechanized force, how can this best be done as regards petrol?—for both vehicle and formation should have as much with them as their tactical efficiency will permit, supply columns should carry it in the most convenient form, and the mobile base should be able to hold and handle it in ample quantity, quickly, conveniently, and safely. Petrol and lubricants, above all other stores, should exist in ample mobile tonnages in forward areas.

Of recent years it cannot fail to have struck an observer how, in the motor-car industry, the capacity of the vehicle's fuel tank has been gradually increasing, although at the same time reduction in fuel consumption has consistently been sought. Even in the province of the light car the process may be seen: every few years, the purchaser finds his new model fitted with a larger petrol tank than its predecessor had. In particular, the commercial vehicle's capacity for self-containment in petrol is steadily increasing year by year. Let us take a typical load-carrier, one of thousands on the road to-day, and note its details. It takes ten tons, and its trailer five. From fuel-oil it obtains twelve to fourteen miles to the gallon, and has an average speed on the road of twenty to thirty miles an hour at need. Its circuit of action is from Edinburgh to London and back without a refill, for it carries with it an ample supply, a ninety-gallon fuel tank strapped to the side of its chassis. If its power of self-containment were still further increased by the carriage of a few days' rations for its small crew, then it would be a self-contained colossus, able to take a country in its stride.

Another development of recent times has been the great increase in the number of roadside refilling stations; yet despite the added facilities they offer, design is being directed towards a greater fuel capacity. It may well be that the present trend in design in the motor-car industry towards more power, greater load-carrying capacity, and larger fuel tanks, will automatically bring about in the military field and in its supply systems an increasing exercise of the supply principle of self-containment where machine-powered forces are concerned, and that the problem of the maintenance of mobility will solve itself. An increase in the size of the fuel tank of the fighting vehicle would mean an alteration in design, leading possibly to the sacrifice of some armament or some armour or else to an increase in total weight or in engine-power. Here once again, as with the increasingly burdened soldier of the past, the needs of mobility and armed power are seen in conflict.

How will the auxiliary supplies of petrol in the formation be carried? To-day, petrol is mostly carried in cans, though this is supplemented to some extent by petrol-trailers. In forward areas the large lorry-tanker is never seen and presumably, if employed, its use would be confined to rearward areas. The can system of distribution is uneconomical, and has practically been discarded in the United States. It is slowly dying out in this country and to such an extent that, if ever petrol distribution in tins became necessary on a large scale, there might be considerable difficulty in obtaining the containers in the quantities required. The system has, however, the advantages that special road and railway vehicles are unnecessary for petrol transportation, and also the can meets the present difficulty of the frequent refuelling of many vehicles simultaneously. The three-ton lorry will carry about 700 gallons, many are wanted, and so the transport accompanying a mechanized formation tends to pile up, and so militate against the mobility of the whole. To some extent the petrol trailer assists, but it cannot eliminate the many handlings, the final distribution by can, and all the waste of man-hours involved. Any method by which the number of transport vehicles, accompanying a formation or composing a supply column, could be reduced, would be of the greatest value.

Can civil practice teach us anything? There can be little doubt that, if the air menace is to be met by dispersion and reasonable standards of speed are to be attained on the road, military traffic will have to learn to 'run loose': it will have to imitate what can be seen at a week-end on the London–Brighton road. But such dispersed traffic, although it maintains a high average speed, manages to refuel on the road from the many wayside refuelling stations without any appreciable loss in the total time spent on the journey. Nor does such refuelling tend to any congestion, for the vehicle pulls off the road, if it needs petrol. A machine-powered force dispersed over a wide area, and using all available roads, would present a picture not unlike that of civilian traffic. Is it too visionary to conceive military traffic refuelling in the same way as it does? Larger fuel tanks would mean many fewer refuellings—a bugbear to-day—while the roadside station could be made a mobile one by utilizing the services of the large commercial tanker-lorry, which could be stationed off the road to the number, and at the spots, desired. Its services might also be similarly utilized on other suitable occasions, such as when a force was in 'harbour'. The more dispersed the traffic, the quicker and easier, as in civil motoring, would be its refuelling. Petrol carried in such concentrated bulk would mean a considerable saving in the number of transporting vehicles otherwise necessary.

Though petrol holds the field to-day, there appears every indication that it may eventually be supplanted by the heavier extracts, such as Diesel oil, which weight for weight need less storage space, are easier to handle, and hold a greater potential energy. Nor are they subject to the same fire risk or the same loss through evaporation. Compression-ignition engines, using these fuels, are coming more and more into common use; and these small high-speed oil motors show characteristics of an increase of weight of only 20 per cent over that of the petrol engine, a high economy, and good consumption. Their eventual adoption by the military vehicle will lead to a smaller fuel consumption per mile, a relatively smaller weight to be carried, and an increase in the vehicle's capacity for extended and self-contained manœuvre.

Local replenishment, as a principle of supply for petrol and lubricants, scarce needs touching upon, for only in the case of the long-distance swift raid would it be possible; and then the speed and secrecy would have to be such that lack of time and an owner's natural disinclination to destroy his wealth might together present the raider with these valuable commodities.

Lubricants have not been dealt with specifically, for though second only in importance to petrol or fuel-oil, they are a companion store, and their consumption bears a direct and ascertainable relation to that of these fuels.

Spare Parts

An army is a factory and storehouse for standardized products; it is a mass-production machine. To achieve its ends, and largely through the instrumentality and needs of its discipline, its components must be trained or manufactured to a set pattern, if they are to take their place as efficient and easily interchangeable parts of a whole. The soldier is the civilian standardized and uniformed; the shell is the ballistic spare to replace loss in the gun's equipment; the mess-tin strap must be able to fit snugly where another was.

The essence of supply is the proper control of the replacement or spare of all kinds in its receipt, its storage, its transportation, and its expense. Is it too much to say that even the Art of War may be read in terms of the spare, human and material, and its correct utilization? Or that in the future the emphasis will not be on the mechanical, rather than on the human, reinforcement? With battle imminent, and a Medium tank immobile for lack of the replacement for some defective and vital part, a magneto or even its 'make and break' spring, the item though small, inexpensive, and in the ordinary way negligible, may then assume a value infinitely greater than even a replacement for the tank commander himself, should he be a casualty. And the further removed from its sources of supply, the greater will be the value of the metallic reinforcement: a man may replace a man, but nothing else that particular item. Without it, the war organism cannot carry out its function.

The spare part is unlike other forms of supply: its likely demand is not a definitely calculable quantity in advance, like the ration; its particular necessity cannot be estimated for, like petrol and lubricants; yet its urgency, when it arises, is possibly greater than anything except the latter. The time, and place, and occasion, of its need can never be foreseen. None can say what will break or fail, or when or where: a front axle radius rod may snap, when going over a paltry ditch; a valve may be blown through a careless tappet adjustment; or a fabric transmission joint disintegrate, as a result of heavy going.

As a 100 per cent precaution, there might be carried up with the unit or within a reasonably close distance a duplicate of every component, which goes to build up the whole; but mobility forbids the presence of heavy tonnages and a mass of non-combatant stores-carrying vehicles. A course must be sought between a lack of the essential spares and an unnecessary plenty. Where is the safe middle course? A visit to any roadside garage which advertises itself as a qualified agency for the repair and upkeep of some particular make of car will reveal the surprisingly small stock of spares which are held on the garage racks to meet repair contingencies. The proprietor is out for business efficiency. He will not lock up more capital in spare parts than the bare minimum necessary. He grudges valuable accommodation for their storage, and he has no labour to spare on their proper preservation in store. But he realizes that his customers' needs must be met, and that they must be satisfied. His aim is a light floating stock, which will lie on his shelves for a minimum of time, and which is composed of items which he knows from experience have a high frequency of demand. If any exceptionable replacement should turn out to be necessary for the job in hand, then it can always be obtained from the wholesaler at the cost of some little delay.

Our problem presents few difficulties in its broad outlines: the track plate pin of a tank needs more frequent replacement than the plate; a tyre cover is more in request than a wheel; and a motor-cycle Ferodo clutch ring than a handlebar. Maintenance in peace gives the experience, and there is no reason to expect that active service will do otherwise than confirm it. Given such information, equipment scales, loading-tables, and reserves may be built up. The average frequency of issue of each part of a vehicle, per hundred vehicles of a similar kind, per month, is an ascertainable figure; and so the requirements of any force, composed of a specified number of specified vehicles for a specified time, can be foreseen with a reasonable prospect that the great bulk of all likely demands in the field will be met.

Going a stage further, it will be possible even to lay down, and implement, any degree of repair-mobility required. For example, for a pursuit, or similar operation where the accompanying non-combatant vehicles should be at a minimum, those replacement-spares only would be carried whose normal frequency of issue had been proved from experience to be of the very highest. Their presence would guarantee the repair of the commonest class of casualty; and casualties of a less common kind would then obviously have to be abandoned, as the foundered troop horse is left, and salved at some later and more convenient time. Again, when less mobility was in demand, as in operations against non-mechanized troops, items of lower categories of frequency of issue would be carried with the formation. By their presence a greater field of likely repair necessities would be covered, and there would be every likelihood of units arriving in action at 100 per cent strength.

Such commonly used items, or 'live' items, have their prototype in the 'best seller' of commerce. It is not without profit to the mechanized soldier to glance occasionally at trade practice. The following, for instance, is some advice given in a trade treatise[1] on the subject of the 'live' item, and the authors are speaking of efficiency and economy: 'It needs also the constant and careful observance of the following points:

1. Re-ordering promptly quick-selling goods.
2. Maintaining adequate stocks of staple goods.
3. Seeing that proper ranges of sizes, models, etc., are maintained:
4. Forcing out slow-selling goods.'

Here in brief—it can hardly be better expressed—is the best of guidance for supply in forward areas.

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[1] Chitham and Williams: *Principles of Store Practice.*

Experience shows that 'live' items are small in weight and volume when compared with 'dead stock' items, or those seldom in demand; and that they represent a very small percentage of the vehicle's total components and accessories. A rough test carried out in connection with the wastage in spare parts of a well-known make of motor-cycle revealed that of 3,000 items listed as cognate to the machine less than 4 per cent could be labelled genuine 'live' items. Briefly, it is the first five or six dozen most commonly demanded components of a vehicle which cover over three-quarters of the total demands made in connection with its maintenance. The motorist will recall the frequency with which the same spares have been found necessary by him for repairs to his successive models. What does he do, when he leaves the garage-littered highways of civilization to traverse a Sahara, or blaze a trail through African wilds? He trusts to replacement-repair with the aid of an essential minimum of spares, selected in the light of experience, coupled with a careful forecast of the likely conditions of ground and weather and the time which must elapse before he may expect any replenishment.

In mobile operations in the past the great bulk of the casualties have been due to accident of climate, terrain, and hard marching; and there is little reason to suppose that the same causes will not be responsible for vastly more injuries to the mechanized vehicle than those due to hostile action. So, providing the severe wear and tear of war and particular conditions of terrain and climate be taken into consideration, peace experience forms a reliable guide for the mechanized spare in war. And insurance should be made against the normal, rather than the abnormal, risk.

Let us visualize at a newly forming base overseas freshly landed personnel struggling with the problem of rapidly identifying and arranging on a logical plan a chaotic medley of mechanized spares, war reserves hastily thrown across the seas, while calls for spares and more spares are pouring in from mobile formations, the first to be launched into the interior. The great bulk of the personnel available to handle these will be composed of men who will have had no recent or very intimate knowledge of them. The problem of identification was not so serious in the Great War: time was not so valuable; nor were stores so technical; and old-fashioned, long, and cumbrous nomenclatures sufficed for His Majesty's stores. But in the future the mechanized spare must be quickly distinguished and easily demandable, and some system by which this may be so, even for inexpert personnel, is essential.

In the motor industry every spare part bears its identification or code number in the same way that every soldier bears an army number, and something of the sort will be necessary, if only to ease the inevitable congestion in wireless traffic to which urgency may fly when vital spares are lacking in forward areas. Long lists of cumbrous nomenclatures will have little chance of a hearing, when operational messages are also clamouring for transmission. It appears reasonable—so much does the vehicle lean on its spares—that they will have to arrive at a seat of war ready numbered and racked, so as to permit of the earliest identification and issue when needed. At present there is a multitude of makes, and hostilities will mean the tapping of all sources of supply; but simplification will come by way of the gradual standardization in industry consequent on the growth and development of the big transportation firms.

No supply officer can foresee every contingency which may happen to man or machine, but the foregoing suggests a way by which the machine's endurance may unquestionably be maintained from light tonnages up with its formation, while relegating to backward areas the large and necessary mass of transport filled with heavy stores and machinery. Where, and how, will these stores be carried?—for they must be quickly available for the soldier. In peace, he is accustomed to go round the corner to have his needs met; and in the field they could equally well be met by a very diminutive depot on wheels attached to his formation, carrying spare parts and perhaps a minimum of the lightest labour-saving machinery. Light organizations of this kind already exist, and will undoubtedly constitute the main pillars in the edifice of repair. Their stocks would reinforce the equipment-spares of the unit; and in this way a considerable measure of self-containment would be assured to the formation. Replenishment, when necessary, would be effected by periodical convoy from the mobile base, where would also lie the reinforcement spares for the maintenance of the convoy vehicles themselves.

History teems with examples of mobility impeded, either by a lack of replacements or by their superabundance, and when we turn to recent times we find the same thing. We find Forbes, the Ordnance historian, depicting the many evils attendant on the grave lack of spare parts for M.T. vehicles on the Western Front in the early days of the Great War.[1] There, machine cannibalism set in to such an extent on this account, that in many a case where a vehicle was eventually returned to a base for complete overhaul it was found that what had arrived was merely a useless shell. Indeed, many a vehicle from this cause disappeared entirely. There was a great disinclination on the part of the man near the Front to part with his machine, as its repair might involve a long stretch of absence. Highly skilled mechanics had to be turned on to make slowly and extravagantly by extemporized methods ordinary mass-production spares, for which the necessity had suddenly become urgent. As a result, early in the campaign before conditions stabilized, many a repair had to be, and was, effected *in situ* with any labour or material available.

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[1] Forbes: *A History of the Army Ordnance Services.*

In another theatre of war, Mesopotamia, we find the same unfortunate, and at the same time unavoidable, lack of spares. A writer[1] who served through the campaign voices the complaint of the harassed supply officer thus: 'The lack of spare parts has been sorely felt; the number of vehicles off the road being no indication that the workshop staff was not doing its duty.' All through this story of the campaign's supply runs this dominant note. The cry is never for workshops, nor for skilled personnel, but for replacements, furnishing proof that it was towards repair by replacement that efforts were directed. In another place, the author makes the striking comment that the fewer the essential stores, the greater was the necessity for the extravagant and cumbersome workshop and its expert personnel.

The same theme is harped on heavily wherever the vehicle was employed in active operations. Thus, in a preface to a history[2] of the Tank Corps in the Great War, are depicted the difficulties confronting the tank maintenance staffs on the Western Front: '. . . the soldier-engineer overburdened with difficulties of maintenance and cursed with the nightmare of Spares and Spares and more Spares'.

[1] Leland: *With the M.T. in Mesopotamia.*
[2] Williams Ellis: *The Tank Corps.*

PRIMARY STORES

Food and Water

How can we best apply our principles of self-containment and local replenishment to the soldier's food in operations of speed and dispersion?—if the mobility of his formation, and that of its units, is to have full play. Napoleon's mobile soldier carried simple fare with him, but many days of it; and he also pillaged the countryside to replenish his pack. The far-marching Roman legionary kept himself in the same way. The fighting vehicle is a powerful carrier, and its men are few; even the lorry or bus laden with personnel has the first of these virtues; while both have the speed to cover quickly successive areas and so, if necessary, may exploit their resources.

If he is to be mobile, the mechanized soldier can hardly expect the comforts of his predecessors in slow-moving operations, for much will be demanded of him and of his vehicle: he cannot expect the guaranteed luxuries of fresh meat and bread, to effect the supply of which rearward organization before the Great War was largely modified. These will be permissible only when operations are quiescent, or when he is back at some fixed base where heavy tonnages do not matter, or when he can requisition them from local resources. Mobility has almost invariably gone with some hardship and simple fare: the Scottish Highlander of the past had his cloth of oatmeal; the Boer relied on his biltong; the

North American Indian had his pemmican; and the Turkoman raider the chopped fodder and meat ball for his mount. To-day, the canning industry offers a wide field for experiment in this direction. In a valuable description[1] of mobile operations in the Palestine campaigns it is related how, to gain more mobility, certain mounted units were trained to work on a limited ration; and to the same end in their instructions for the final advance on Aleppo, mounted troops were warned that, though calculations had been based on the scale of the 'mobile ration', they might be called upon to do double distances on half-rations.

The agricultural richness, or the water supplies, of a certain tract of country has often been a main factor in determining the line of advance. In the future, this may not be so compelling a factor on account of the low man-power and capacity for self-containment of a mechanized force.

Who will do the foraging for the formation? If it is motorized, its personnel will be ample for this purpose, but many have to be fed; if mechanized, there will be few to be spared for this scattered, individual work, and moreover the soldier away from his armoured vehicle is shorn of much of his strength. Skilful foraging is an art, won from experience; but, if on a large scale, time is necessary, and this the speed of operations may not allow. Nor owing to the lack of protection such as a widely flung front gives, will the work of foraging for the formation be other than somewhat precarious, and particularly in the case of parties sent far afield. On the other hand, a mobile base would be able to exploit local resources by the use of its defence personnel and reserves. It might even come to be in some sort a 'rolling magazine', to which as a temporary centre locally requisitioned supplies would be collected. Successful local replenishment will lessen the supply tonnages to be brought by convoy over long distances from the rear, and will permit of a greater measure of self-containment in other essentials. The activities of Sherman's skilled foragers in 1864 obviated the necessity of drawing on his accompanying supply trains, until within a short distance of his final objective, Savannah, on his famous march from Atlanta to the sea.

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[1] Prestwick: *The Desert Mounted Corps.*

A desert has always proved to be the most formidable of frontiers against invasion, owing to its lack of water; for its quantity has governed the strength and composition of a force, and its locality, the direction of advance. Forces of heavy man-power, and particularly of heavy animal-power, consume an immense amount, and its carriage in bulk presents many difficulties. In the Palestine campaigns, on certain occasions horses went without water for fifty to eighty hours; on others, a force had to be built up with infantry instead of mounted troops, for an animal needs about four times as much water as a man. The problem with a low man-powered force assumes much smaller proportions, and the vehicle's carrying capacity minimizes the necessity for an accompanying water-train. Its potential self-containment makes the mechanized force much less dependent on existing water sources. Let us give one example, although on a small scale and in the favourable conditions of peace. It speaks for itself. During a long-distance test, carried out in Egypt and the Sudan in 1933 by a convoy of a few M.T. vehicles, part of the journey was over the well-known 'Forty-Day Route', which was used in olden times by camel caravans. From Assiut to Selima Oasis it follows the Darb el Arbain across the desert for some 600 miles, and there are three water points only on the route. The M.T. vehicles covered the distance without undue trouble, over a track sign-posted by the skeletons of camels.

The Reduction in Supply Tonnages

The mechanization of forces cannot fail to bring with it a large reduction in supply tonnages, consequent on the disappearance of the horse, the smaller man-power involved, the nature of the new material, and the mobile conditions of warfare.

With the elimination of the horse, there goes also much of the bulky tonnages of the Great War: all the mountains of forage, the dumps of horse-shoes, the stacks of harness, the picketing and watering gear, and the veterinary stores, which were so much in evidence then. An immense amount of transport and rolling stock formerly devoted to their carriage will be saved. The reduction of the animal has been final, once the machine has taken its place. The reduction in men, however, tends to be progressive; and the personnel of machine-powered forces must inevitably and gradually diminish from two causes: firstly, as a policy of mechanization supersedes in time that of motorization, combatant man-power must also decrease in the unit and formation; and secondly, personnel will grow less in numbers, as model replaces model giving an added efficiency to the machine. A smaller man-power in the field will mean that the soldier's own requirements—food, blankets, boots, clothing, and other comforts and necessaries—will diminish considerably. Now, a general characteristic of the stores and equipment peculiar to man and beast is their bulk and their lack of concentrated weight: they are amorphous, fibrous, cumbersome in handling, often perishable, and in storage and on the move their tonnages are voluminous. The peculiar needs of man and animal, in addition, call for a hundred and one specialized activities, bakeries, butcheries, cold-storage plants, hospitals, and camps, all necessitating further attendant personnel, which have to be maintained.

An analysis of the stores and supplies required by a normal division, comprising approximately

17,000 men, 5,500 animals, and 900 M.T. vehicles, gives some indication of the likely saving in tonnage which would accrue on the abolition of the horse and also on possible reductions in man-power. Excluding its needs in ammunition and baggage, the daily lift to such a division has been approximately 150 tons of all kinds, comprising

Hay and oats . . .	53 tons
Food and cooking fuel .	54 ,,
Petrol	20 ,,
Lubricants . . .	1 ,,
Ordnance stores . . .	10 ,,
Other stores . . .	12 ,,

It will be seen what a preponderating demand on transport food for man and beast have made. But large though the man's needs in food bulk, they pale before those of the animal; for, in weight, the horse needs approximately six times as much as the man. Further, man and animal must eat whether working or not, whether operations are active or quiescent; but the I.C. engine only when working. How much shorter the supply column of the future should be! The reduction in the transport of maintenance brought about by the introduction of the I.C. engine into a combatant formation may be gleaned from a study of the campaign of pacification undertaken in the spring of 1934 by French colonial troops in the south-western, and last 'dissident', districts of Morocco.[1] There, in the round-up of mobile, elusive, desert tribes, long distances were covered by a formation, part mechanized and part motorized, comprising 400 vehicles, which were easily maintained by a supply column of seventeen transport vehicles only, and these carried water in addition to other necessities.

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[1] See the *Revue des troupes coloniales*, 1934.

The machine's requirements, although they cover a vast range in number and variety, present certain general characteristics: its stores are of mineral or metallic origin; they are small in bulk, though condensed and heavy in weight; they lend themselves to standardized storage and packing; and they can be handled easily and conveniently. The transport needed, in proportion to the service given, is consequently small.

In operations of speed, in which mechanized forces are engaged, there will be little or no necessity in forward areas for heavy engineering material, such as road-metal, timber, tar, sand, and concrete; nor, while mobility lasts, will the cumbersome stores of trench warfare be in evidence—the barbed wire, the sandbags, timber, hutting, shelters, and the like. Tonnages of ammunition should also go down, for in mobile operations there cannot be the sustained and heavy expenditure of it which was common to the slow-moving operations of the past. On the other hand, the great growth of air forces will call for the carriage by ground forces of adequate tonnages of anti-aircraft ammunition for their protection. Their extent, however, remains a problem for the future.

REDUCTION IN SUPPLY TONNAGES

In machine-powered forces, supply tonnages will in general be governed by the extent to which they are either mechanized or motorized; for large man-power above all things means large tonnages; and man, of all things in war, is the most expensive to maintain. A study of the table below reveals the reduction of tonnages consequent on mechanization.

COMPARISON OF LOGISTIC DATA OF TWO UNITS OF APPROXIMATELY EQUAL FIRE POWER

	Mechanized Cavalry Brigade	*Horsed Cavalry Brigade*
Strength—Men	2,346	9,275
Animals	—	10,714
Vehicles (all kinds)	771	910
Class I Supplies for 1 day (tons)*	81	92 (less 75 tons hay)
Gasoline and oil for 1 day (tons)	76	15
Mobility factor (miles of travel per ton of Class I Supplies)	1·84	0·27 (less hay)
Length of Column (miles)	14·2	19·2
March per day (miles)	150	25
Day of Fire (tons of ammunition)	140	157
Fire power per man (lbs/man)	120	34
Standard R.R. trains for a movement	14	57
Ship tons for overseas	25,000	185,000

* Class I Supplies: Food and fuel for men, animals, and machines, i.e. the raw material of mobility.

Let us continue in the compiler's own words: 'Particular attention is invited to the much smaller number of men in the mechanized unit, which means less casualties, the greater "mobility factor", and the greater fire power per man engaged in battle. Most of all, let me stress the fact that in the mechanized unit only one-fourth as many men are exposed to casualty as in the muscle-propelled unit, and it is the casualties (both dead and wounded) that represent the highest cost of war, both in money and in human values. Mechanization lets the machine do most of the dirty work of war, while more men stay at home to produce the greatly increased number of fighting machines required.'[1]

So to conclude, the greatest of all arguments in favour of the employment of an entirely mechanized force appears to be that, so far from its supply being likely to strangle its mobility—as critics aver, its elimination of heavy man-power will mean the abolition of the colossal supply tonnages of the past. Thus by way of the fighting vehicle, and low man-power, will be once again recovered a mobility of manœuvre, lost since the Napoleonic wars.

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[1] See Major John K. Christmas, 'Tanks and Tactics' in *Army Ordnance* (U.S.A.), January–February 1937. The American mechanized cavalry brigade, which he deals with in his comparative statement, consists mainly of light tanks.

Chapter Fifteen

REPAIRS

Repair in the Field—In the Great War—Civil Analogies—Skilled and Semi-skilled Repair—The Repair Lay-out—A Warning

Repair in the Field

In any consideration of the subject of repair, it is an elementary precaution to appreciate first the exact significance of the word; to realize the different meanings of a term which designates so important a branch of supply. In *Chambers' Dictionary* the word is defined, among other things, as either 'the restoration after injury or decay', or alternatively as 'the supply of loss'. So in the case of a wounded man, repair means renovation or renewal; in that of the machine, almost invariably the replacement of a part. In the world of motoring, it needs the skilled fitter with his bench, his lathe, drill, and file, to fulfil the first of these functions; while any garage youth of average intelligence, by the replacement of the old with a new part, may carry out the second. The two sets of operations can be looked upon as distinct, although, in the nature of things, the division between them cannot of necessity be clear cut.

When the world of mechanics was in its infancy and mass-production yet to come, the term 'repair' spelt more often than not 'restoration', rather than 'supply of loss'. Mass-production now holds the commercial stage, and in natural sequence mass-replacement has followed, ousting the former 'restoration' or making-good of the damaged article. Indeed, much the greater part of what comes under the generic, and oft abused, title is a matter of mere replacement.

In the Great War

When a vehicle becomes a casualty in the field and needs repair, three courses are open: it can be repaired on the spot by such personnel, and with such stores, as are there; it may be brought to the repair organization; or the latter may be brought to it. How has the problem been dealt with in the past? And to what extent has its solution been governed by the conditions obtaining?

In the operations on the Western Front in the Great War, we find a vast administrative zone rendered more or less safe by an almost impregnable trench system in front of it, and in which stationary workshops, like other administrative installations, were on a lavish scale; while their small mobile counterparts, where these existed, were seldom called upon to exercise their mobility, and the proportion of repair effected by them was relatively small. When operations became fluid, the latter, though ostensibly designed for just such conditions, failed in their purpose and became, like the stationary workshops, merely so many centres for repair. When, however, mobility had to be maintained at all costs, as in the case of the tank made a casualty on the actual battlefield, a system of replacement-repair *in situ* by the tank crew with the aid of complete assemblies was practised. This employment of the complete heavy assembly was practicable, as distances were very limited and the warfare hardly mobile, as the word is understood to-day.

It may be said, in general, that repair was centralized and effected by expert labour: the casualty was brought to the repair organization where, after repair, it was placed to stock for eventual re-issue. But the system demanded above all things for its successful operation time, regularity, and a guaranteed security. This guarantee, the front made good.

Can it ever be guaranteed in swift mechanized warfare? Will it be possible so to deal with casualties dotted over large and possibly hostile areas? Is it in the nature of things that any commander will be—or ever has been—held back from endeavouring to destroy his enemy by any hampering considerations for his casualties, whether ships, men, or machines? Hence—no other assumption is reasonable—there will be no time for the orderly, accurate, and specialized repair of the stricken machine by skilled technicians in the danger zone. The crew of the vehicle will have to do their own patching-up as best they can, and get on with the fight.

In the campaign in Mesopotamia, there were conditions which might well be expected again in colonial warfare: native sources of supply for the mechanized vehicle were non-existent there; large towns were few, and so were buildings suitable for conversion to workshops; roads were scarce and bad; and distances were great. After the occupation of Baghdad the dispersion of the force necessitated a similar dispersion of the M.T. supply vehicles. Centralization in repair was no longer possible to the extent it had been, and recourse was had to the services of the mobile workshop. But in virtue of its function its mobility was limited, and it was sited as a rule in buildings at the headquarters of an M.T. formation, from which lorries worked outwards and back. Leland, in his account of their work,[1] writes that 'whenever operations were in progress, it was practically impossible to utilize the workshop. . . . The mobile workshops as a rule were kept close to the front in which their units were working.' He shows how, when the troops really moved, centralized repair at large fixed shops was impossible, and that the mobile workshop was also largely ineffective. And these were the difficulties in maintaining a force which could move at a foot-pace only!

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[1] Leland: *With the M.T. in Mesopotamia.*

Civil Analogies

Some still advocate adopting methods, somewhat like the foregoing, and as used by the big transportation companies, which are briefly a large-scale salvage to large stationary shops of the casualty, its re-conditioning there, and the immediate issue of a fresh vehicle in lieu. This, however, presupposes the existence of large reserves; and at the opening of hostilities, when a mechanized force would be used to its full capacity and when there would be a call on every vehicle, the likelihood of any large stock of reserve vehicles seems highly problematical. Moreover, a general salvage to central points at long distances connotes the presence of many non-combatant recovery vehicles, which would need protection, and so would be a drag on the force. Mobility cannot go with heavy recovery and repair: the two are opposed; and the more the former is in request, the less the feasibility of the latter. A commander cannot have it both ways—both speed and heavy repair: he must be prepared to abandon his serious casualties, and cut his loss.

We have another picture in civil life more truly analogous perhaps to what may be expected during the scattered operations of a mechanized force. All over the country, a widely dispersed motoring public is maintained on the road through the exertions of the wayside garage. Let us pause, and note the detail of its activity. Its work is carried out almost entirely by cheap semi-skilled labour of a standard which is certainly not up to that of the army fitter, or of his trade unionist brother. The heavy routine work, the dismantling, and the re-assembly, is done by the garage hand with the aid of the handy standardized spare. When difficulties arise, there is always the skilled foreman to give the necessary advice or to do the requisite fitting. There may be said to be a rough division of labour between that at the expert's bench, and that on the floor.

Skilled and Semi-skilled Repair

We are faced with two alternatives for repairs in the formation:

(*a*) repair by skilled personnel in mobile workshops up with the formation; or

(*b*) rough-and-ready replacement-repair by the combatant himself, reinforced by expert repair in workshops well to the rear for casualties beyond his repair-capacity.

We will consider (*a*) first, and then (*b*).

(*a*)

There are two main classes in an army to-day, the plain soldier and the trained mechanic; and the presence of layman and expert only would point to the unavoidable necessity for repair by the expert in the workshop, and by him alone. No other course appears open. But without looking further into the matter, is not this too hasty a conclusion to come to? A warfare of speed and dispersion forbids any centralization of repair activities. Moreover, mobile workshops, even though able to move, are really machine-hospitals; and a battlefield cannot be a suitable locality for the proper healing of man or machine. Its whole atmosphere is the very antithesis of that needful for this peaceful and careful art: the latter is a static function, while battle is dynamic. Time, regularity, and some measure of security, are conditions essential to its due performance. The two first can never be guaranteed by a commander amidst war's harsh alarms; while the last on a battlefield is an impossibility.

Within a short time from the commencement of hostilities casualties due to accident of travel, enemy action, or other cause, will be occurring at the same time in many parts of a large fighting area. Calls for assistance will increase and increase, till the harried workshop will simply not be able to cope with them. It will be snowed under. With each additional patient on its hands —just picture the growing ring of derelicts in every stage of repair around it—it becomes more earth-bound, more of a drag on its formation, till finally the Sword of Mobility sticks in the Sheath of Repair. Be it remembered that, at its best, war is but a rough-and-ready business where the perfections of peace can seldom, if ever, be attained; and where the slogan of the soldier must be ‘Patch up, and get on’. We must seek some better way.

(*b*)

In the motor-car world there are three classes of workmen, taking them by and large. There is the skilled mechanic, who has passed through an apprenticeship and is more often than not a member of a trade union: he may be fitter, turner, electrician, coppersmith, or one of a hundred things; or he may be one of the old-fashioned type, good-all-round at several jobs. Then there is the semi-skilled man, the product of an age of mass-production; and his degree of skill may be anything from the heavy handed practice of the garage youth up to a standard equal to that of the skilled man. The motor trade depends on this type of man, and big production and repair organizations employ his services largely and economically. The owner-driver, who from motives of economy or interest does his own repairs, may also be said to come within this category. By such labour, and with the aid of the necessary spare, the great part of the motoring public is maintained on the road. Finally, there is the unskilled labourer with no mechanical knowledge who is the civilian prototype of the ordinary private soldier.

Our problem must inevitably find its solution in the capabilities of the combatant soldier himself. Progressive training, which has for its aim a standard equal to that of the keen owner-driver, will be the road towards its solution. The convenient wayside garage will not exist in war; but the vehicle-crew will take the place of its semi-skilled labour, and the 'live' item its spares. When difficulties arise, there will normally be an expert about, some formation fitter to give assistance or mechanical engineer to give advice; for the latter will be to the machine what the regimental doctor is to the man or the squadron vet. to the horse. In this way, the vast work of repair is spread over the force as a whole, and it is decentralized; while at the same time the valuable expert is relieved of a great deal of simple work, which should not necessitate his attention. To waste the time of an all-round mechanic on such work is to go back to the dark ages, when things mechanical were in their infancy and mass-production had not set in.

It will have been noticed that the foregoing suggests a yet further embodiment of the supply principle of self-containment in the formation. We have been enabled by the help of our supply principles to be consistent, even in the realm of repair; for the mechanized formation now carries with it, and as part of it, its own repairers, and to facilitate their work of replacement-repair there also accompanies it a minimum tonnage of high frequency-of-issue spares.

The Repair Lay-out

What should be the repair lay-out?—the formation, its convoys, and its mobile base, all need consideration. With the first, as we have seen, repair means replacement-repair effected almost entirely by the semi-skilled labour[1] of its units. There should be no hard and fast dividing line between the repair done, or able to be done, by the vehicle crews and that carried out by the workshops in rear; for the more the soldier can himself handle in forward areas, the less will be the casualties to be recovered to the rear later, and so the less the load on supply services. It must not be forgotten that the fighting vehicle's repair becomes most urgent at those very times when all expert assistance is farthest removed from it. Its efficiency, and even life itself, will depend then on the crew and their knowledge. For this reason alone, any ill-advised attempt to dam the soldier's desire for more scope in effecting his own repairs will itself be damned.

In the periodical convoy, running between mobile base and force, repair is simpler; for the near end of its travel, the mobile base, will not be subject to continual changes of position, like its forward delivery end, the force. Two forms of repair are possible: firstly, a rough-and-ready replacement-repair, while in movement; and

[1] An example may already be seen in the introduction of the semi-skilled grade of driver-mechanic.

secondly, heavier repair in mobile workshops, forming part of the mobile base.

At the latter, fifty or more miles in rear, repair would be heavier, more thorough, more technical, and less mobile. Here would be vehicles containing high-grade machinery; reserves of high frequency-of-issue spares, but covering a more comprehensive field of requirement than those with the formation; expert departmental mechanics working under conditions of some security and routine; and finally, here would be waiting the technical recovery vehicles and machine ambulances, whose business it is to retrieve the heavy casualty from forward areas, as opportunity offers. When the base moved forward during periods of inactivity in mobile operations workshops and parks, or portions of these, would be able to give still more assistance in the general work of repair, and so relieve the troops of a portion of their normal maintenance repairs.

Generally, the more active and mobile the operations, the more must the function of repair be dispersed and decentralized; while the more inactive and stagnant they are, the more it may be centralized. As a whole, it should be functionally mobile and the business of the soldier in forward areas, and gradually, as its *habitat* moves to the rear, it should be more and more of a departmental matter and less mobile, until it reaches the final immobility of the stationary workshops at the main base on coast or frontier.

A Warning

Repair, as a form of supply, may well tend to weaken the efficiency of machine-powered forces, by gradually piling up man-power for its service. A writer on industry[1] has said: 'As labour has been squeezed out of essentials, it has flowed into the superfluities—or the new necessities, as you please—with the same old-time clock on the wall.' As mechanization in its growth and spread squeezes out man-power from combatant formations, the released labour may tend to accumulate in rearward services, to flow into the superfluities. Then mobility will suffer. And mobility must be thought for, sought for, and if need be, fought for.

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[1] Chase: *Men and Machines.*

Chapter Sixteen

MAN AND MACHINE

Systems and Principles—Man-power and the Lack of Mobility—Machine-power and Mobility

Systems and Principles

Supply systems endure for so many a military generation that their underlying principles are buried and lost sight of beneath all the inevitable accretions of administrative ritual. In earlier chapters, they have been analysed to disclose these principles; and the principle has then been reinforced by examples taken from history. We have shown how in early times the army or formation carried all its needs with it, so embodying the supply principle of self-containment; and how later, as armed man-power grew, this principle gave place to that of a continuous replenishment from the rear. We have shown also how, when release from a prevalent lack of mobility was desired, this has been attained by an embodiment of the principles of reduced self-containment, as exemplified in the flying column; or of local replenishment, as exhibited in the raid. It may be said that such analysis has been subject to error, and that a principle so extracted is ill founded. But even so, better surely some signposts in the labyrinth of supply than none; for a knowledge of the principles of maintenance is necessary, if the necessities of the new warfare, founded upon the power of the machine, are to be met by appropriate supply systems.

It may be asked: Why go back to an ancient civilization—as we have done—for precept and practice? Why not confine inquiry to modern warfare, to the campaigns of the last hundred years? The reason is that to-day a revolution in war's movement on land is taking place: one due to the replacement of muscular movement by that of the machine; and one to which, in its far-reaching implications, even the changes brought about by the introduction of gunpowder in the military sphere or the adoption of steam in the maritime are scarcely comparable. The soldier is faced now with no gentle evolutionary change, calling for the stereotyped study of a recent campaign or two, but with actual change in war's basic unit itself—a change in which force is being built up on, and around, the machine and not the man, and in which the latter becomes the animate component of the former. Change so revolutionary demands the very widest possible field of investigation and study, if the new problems it entails are to be solved. And where better to go in the first place than to the very fount of Western civilization and most of its arts—Rome? Military reformers of the sixteenth and seventeenth centuries in their perplexity took from her wisdom, in the pages of Vegetius; military rebels of the latter half of the eighteenth century turned to her for aid in breaking away from the prevalent immobility in war; the legion and its supply methods were re-born in the division of the Armies of the Revolution; and Napoleon exploited this, winning a mobility and independence of manœuvre which has since been lost.

Each era in war has its own peculiar systems, which have helped or hindered the combatant's freedom of manœuvre, according as their underlying principles have been used or abused; and the longer established the system, the more abuse has crept in. For as it is with a man growing old, so with a supply system after decades of use and habit: its form grows adipose; its articulation, rigid; and its organs, sluggish. History, however, makes it clear that the soldier has been most mobile and strategically independent when he has been most self-sufficing through a wise exercise of the principles of self-containment and local replenishment. These served the armies of the classic civilizations well, and the Roman legion in particular exemplifies their value when properly used. Later in time, self-containment as a principle of supply, though at first successful in modern warfare, eventually failed; for the massed movement of armies and the increasing bulk of their accompanying transport engendered an increasing lack of mobility. And concurrently, the art of generalship decayed and a pedantry in warfare set in. Then came the brilliantly mobile operations of the Napoleonic wars, in which the value, as supply principles, of self-containment in the French division coupled with local replenishment was re-discovered and advantageously practised. But this was an interlude of genius in the evolution of supply. And armies continued to grow. It was left finally to the methodical craftsmanship of Prussian staff officers in the peaceful years prior to 1866 to devise a system of supply able to cope with the maintenance of great man-power armies.

Man-power and the Lack of Mobility

The system is still employed to-day; but in its turn it has grown old, swollen, and little conducive of mobility. And has not the art of war, due to the prevalent lack of mobility, also sunk to an ebb as low as that in the later decades of the eighteenth century? Is not military pedantry in operations as rife now as then? It is for the future to say. The only possibility of release from the prevailing lack of mobility in war lies by way of the fighting vehicle, its speed and its capacity for self-containment, and its small attendant personnel; it appears as the one gleam of hope in the present morass of immobility, consequent on the numbers of the horde and the incubus of its supply. Failing its exploitation, the present state of affairs can only grow worse, for the horde must needs grow more and more unwieldy, as the mechanism of war becomes more complicated and its armament piles up. Held in front tactically by the power of the defence, to-day so formidable in its machine-gun, automatic, trench, and wire; embarrassed and bewildered strategically by the ubiquitous menace of the aeroplane and the added complication of anti-gas precautions; and shackled administratively by the umbilical cord of its colossal supply stream—what power of any real mobility can it have?

The conditions which confront the military reformer to-day are not unlike those with which his prototype was faced in the late eighteenth century. Then, the mechanism of war, the ritual of its method, and in particular the dominance of its supply, had become such that the small standing army of that era had little mobility; to-day, similar factors, consequent on the huge growth in man-power, have brought about a similar state of affairs. But, then, the builders of the Armies of the Revolution, careless of tradition and ignoring perfection, sought simplicity and built up forces which were to overrun Europe at a speed which nonplussed and defeated their tradition-bound enemies; while, to-day—what? Can a like mobility from a like background of immobility be attained? Industry has produced the means, and points the way through mechanization; but can its advocates overcome the inertia and conservatism of tradition?

Mobility is invariably trained for in peace, and sought for in war; but the lack of it in strategy has been due, during the last hundred years or so, to reasons mainly connected with supply. They are generally:

(*a*) the growth in man-power, and the colossal maintenance entailed;

(*b*) the increase in the variety and complexity of supply, and particularly in warlike supply; and

(*c*) the limited strength of the soldier, the prime carrier in war, which is insufficient to enable him to carry all the armament essential to an industrial civilization's warfare, and at the same time enough food to make him self-sufficing and mobile. Supply, to-day, instead of holding her rightful position as the handmaiden of battle, has become War's mistress.

Machine-power and Mobility

Release from the prevalent lack of mobility in warfare can come only through the weight-carrying capacity and mobility of the fighting vehicle; for its speed and its formidable fire power endows its formation with the gift of wide dispersion, and its carrying capacity permits the formation to be self-sufficing when dispersed. This has been fully exemplified in the far-reaching operations of the Italian mechanized columns in the recent Italo-Abyssinian War, after the enemy had been broken in the four great battles of the Tigre.

Long distances were speedily covered by powerfully armed forces, which in Napier's previous campaign of 1868 in the same theatre of war had necessitated the employment of a light flying column, with all the risks attaching to it. Only in that way then, could a similar release from the slow movement of man-power forces be obtained.

Should the vehicle's capacity for self-containment not be exercised, then its units must rely on some supply system embodying one of the other supply principles. Which shall it be?—local replenishment, reduced self-containment, or replenishment from the rear. The first is possible only for the food of the vehicle's crew, and very rarely perhaps for its petrol; the second is inappropriate, for here we have to consider powerful armament and large carrying capacity, attributes that the flying column of the past has had to dispense with; and the third can only shackle the vehicle's great mobility. The latter, to-day's system, must go, and be replaced by something much more mobile, more elastic, and simpler. For one thing is clear. The grafting on to a swift machine-powered force of a supply system devised and perfected to meet the needs of a slow-moving horde army can only end in its strategical suicide.

Once granted that it is the principle of self-containment which is to be exercised, then the question follows naturally—self-containment in what? The field of comprehensiveness in supply is enormous, and its items are multitude. What shall the formation carry with it? What exclude? Which is vital? And which is not? We are led inevitably to consider specialization in supply. Traced and analysed back to his primitive needs, the supply of the soldier resolves itself into two main divisions: firstly, that required by him, *qua* man; and secondly, that superimposed by virtue of his calling as a soldier. These may be conveniently styled natural supply and warlike supply respectively; and the first permits of movement, and the second of combat. The requirements of the new war entity, the complete fighting vehicle, when similarly analysed, range themselves under similar divisions, which we can best define as motivity supply and war equipment supply. By means of this fundamental principle, war's many requirements may be weighed in their relative urgencies and importance in operations of mobility; and so transport may be limited, and yet carry essentials only. But still more is needed, if mobility is to be attained. Much must be demanded from both man and machine: the first must live hard; and the second must be used, and scrapped, ruthlessly. Such measures assisted largely towards the success of the Italian arms in their mobile operations in Abyssinia. In industry labour costs more than material; and even in war, life, which is labour, is of more value than material.

The maintenance of mechanized forces constitutes to-day the first of all problems. It calls for thought and study, even though to many the subject may appear a dull one. Improvisation in modern war becomes more and more difficult, and the unit's growing dependence on technical and specialized sources can but accentuate these difficulties. The supply system requires planning ahead. Little satisfaction will there be, after an outbreak of hostilities, for him who would suggest that problems of supply will find their solution in war. Supply methods failed at the beginning of the Peninsular War; maintenance was a dismal fiasco in the Crimea in '54; while by the end even of the greatest of wars the problem of sustaining the continuity of advance, once operations became fluid, was never solved.

Napoleon, speaking once to one of his generals, said, 'The secret of war lies hid in communications'.[1] Until the soldier, discovering the secret, can conscientiously convince himself that swiftly moving mechanized units can be maintained over wide areas, his task is still to do. If he can, then he need fear little the final reign of the machine.

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[1] Pierron: *Stratégie et Grande Tactique.*

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